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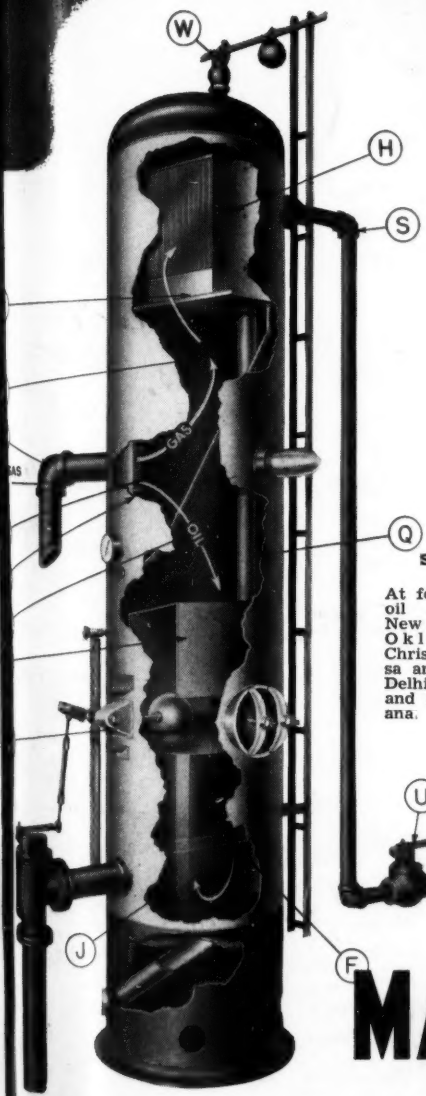

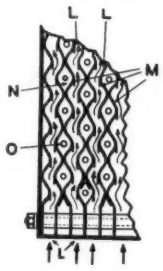

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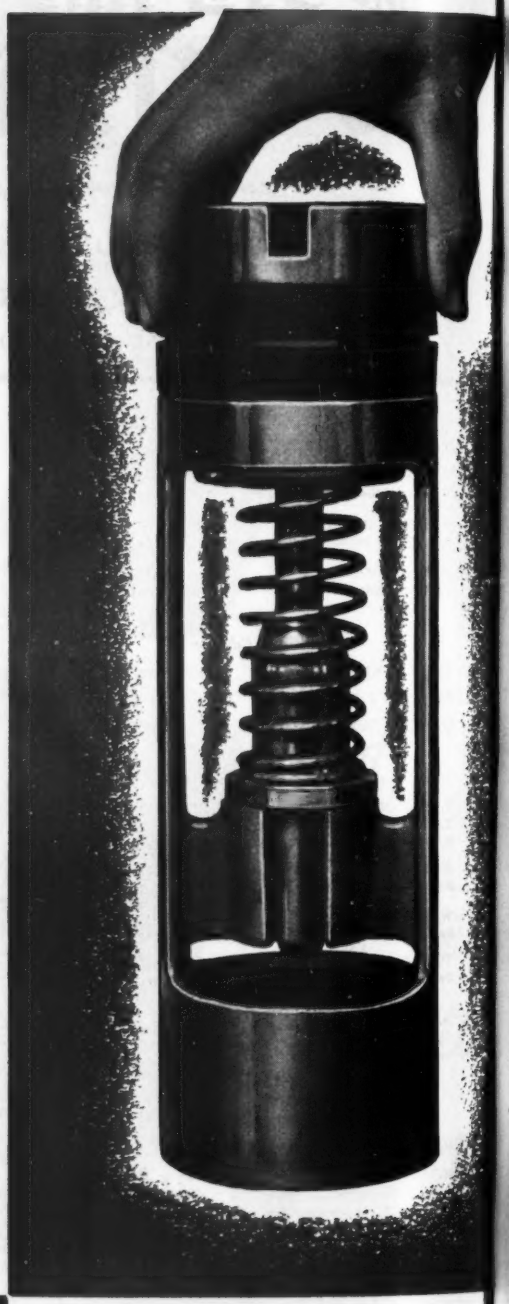

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Telling the Customer

WE have a copy of the letter which S. J. Dickey, president of General Petroleum Corp., sent to the company's customers last week explaining advances in gasoline prices. The upward adjustments applying to the entire Pacific Coast area followed general increases in the posted crude-oil schedules in California.

The advances in retail prices brought reverberations from the politically minded in California, including charges against oil companies which have nothing to do with operations. The Dickey letter is a simple statement of fact which will be accepted by a large majority of petroleum users as an accurate explanation of what had taken place in petroleum prices in the West Coast states. The General Petroleum statement was released by its public-relations department and it is a proper function of that division of the company's operating activities.

The letter first points out that there were no advances in gasoline prices on the Pacific Coast from Pearl Harbor to August of last year. It is explained that the price increases in the company's regular branded grade have totaled 2.3 cents per gallon, an advance which amounts to 17 per cent in Los Angeles. The gain is about one-third the advance in general commodity prices from prewar levels.

The letter concludes: "Higher crude-oil prices have been required to compensate producers for increases in the cost of finding, developing, and producing crude oil. Our price increases have, therefore, come about by the natural pressure of economic events, the increased cost of crude oil, and the general increases in all costs. There is nothing political about them."

What has been done by this company in one area can be duplicated throughout this country. In no product and in no section of the country have there been unreasonable upward revisions in oil markets. The long period of frozen petroleum prices inevitably brought maladjustments in the price and supply relationship of the many products obtained from a barrel of crude oil. The wonder is that this industry, after more than 4 years of rigid crude-oil and product price schedules, could meet the changed conditions of the postwar period without major advances in any product.

Competent observers are predicting that one or more industries will shortly be the "goat" of consumer reactions to constantly mounting costs for the things they buy. The fact that an industry has an exceptional record for low prices while the wholesale commodity indexes in other product classifications range from 130 to 185 is not of itself a guarantee against unfavorable reactions from a confused public. Protection for the oil business lies in taking its customers into its confidence and explaining the why of basic operating changes reflected in wholesale and retail prices.

PETROLEUM—A *PROGRESSIVE* INDUSTRY

Senate Opens Middle East Inquiry Following Moffett's Charges

by Henry D. Ralph

WASHINGTON. — A thorough inquiry into American oil investments in the Middle East, diplomatic commitments in that area, and the relationships between the Arabian American Oil Co. and the U. S. Government has been ordered by the Senate war investigating committee following 2 days of open hearings at which James A. Moffett, former oil man and government official, made a series of sensational charges against the company.

Committee Chairman Owen Brewster announced that former Senator Burton K. Wheeler of Montana had been retained as special counsel to look into the charges and all other aspects of the Middle East oil and political situation and make a report to the committee in executive session.

Moffett's charges, presented in a rambling and somewhat disconnected manner, were to the effect that Arabian American had sought and obtained financial assistance of the U. S. Government in protecting its concession in Saudi Arabia before this country entered the war, and later, during the war, sold Arabian oil to the Navy at exorbitant prices. The Navy contract, he estimated, had returned to the company approximately the amount of its total investment in Arabia so that, as he expressed it, the American taxpayers have now bought the concession.

While neither the company nor the Navy has yet had the opportunity to make an answer before the committee, certain Navy statistics placed in the record indicate that the total amount paid for Persian Gulf oil is considerably less than Moffett's estimate of the company's profit on the transaction.

The object of the investigation, Senator Brewster said, is to ascertain the extent of diplomatic commitments in the Middle East which may be involved in the pending proposal to extend aid to Greece and Turkey and to let the public know what we are in for in supporting governments in that region.

Referring to Moffett's assertion that the British Navy buys oil from the Anglo-Iranian Oil Co., Ltd., at Abadan for 40 cents per barrel while the U. S. Navy pays $1.05 per barrel for similar oil from the Arabian American company, Brewster declared there should be some way for the U. S. Government to "get in on the ground floor." He pointed out that the British Government owns 55 per cent of the stock of Anglo-Iranian whereas Arabian American refused a government offer to purchase part of its stock, but said he did not necessarily endorse this method.

In the spring of 1941, according to Moffett's story, Aramco, the known as the California Arabian Standard Oil Co., was faced with a demand from King Ibn Saud of Saudi Arabia for payment of $6,000,000 per year for 5 years. Being unable to pay and fearing loss of its concession, the company hired Moffett to seek government aid, offering in return a Navy contract for petroleum products at low prices. The Government did not accept this offer but arranged for funds to reach Ibn Saud through the British Government in connection with a British loan then being negotiated. Moffett says this was a satisfactory solution and protected the company's interests. After we entered the war and the Navy needed Persian Gulf oil, Moffett says the company entered a contract at prices far above its original offer. Failure to remind the Navy of the original low offer was a "deliberate fraud," Moffett charged before the committee.

Aided in NRA Code

Moffett identified himself as former vice president of Standard Oil Co. (N. J.) prior to 1933 when, as an old friend of President Roosevelt, he came to Washington first as assistant to Secretary of the Interior Harold L. Ickes in drafting the petroleum industry NRA code and later as federal housing administrator. He then became chairman of the board of Bahrein Petroleum Co., Ltd., and California-Texas Oil Co., joint subsidiaries of The Texas Co. and Standard Oil Co. of California, which companies jointly own Arabian American.

In April, 1941, while still chairman of those two companies, he was retained by Calarabian to enlist the president's aid for King Ibn Saud, he testified. He visited President Roosevelt April 9, and on April 16 sent the president a letter and a memorandum from Calarabian outlining the proposal. The president was much interested and referred the matter to Secretary of the Navy Frank Knox, whom Moffett also visited.

At this point in the narrative a sensation was caused by testimony of the Navy's congressional liaison officer, Capt. Chester C. Wood, that the Navy's files revealed nothing but a memorandum that all papers bearing on this matter had been returned to the White House in May 1944. This was the time when the Government, through Petroleum Reserves Corp., was considering constructing a pipe line across Saudi Arabia and a Senate committee was being created to investigate the situation. Further inquiry, Captain Wood told the committee, revealed that these papers had been transferred to the Roosevelt Memorial Library at Hyde Park and from there to the personal executors of the Roosevelt estate, and could be obtained only by the intercession of the President of the United States. The committee immediately moved to ask the White House to secure the missing files.

However, Moffett produced a copy of his letter and memorandum.

These disclosed that King Ibn Saud's financial condition was desperate. The British Government had advanced him £400,000 and he was endeavoring to have this increased to £900,000. The Calarabian company had advanced between $6,000,000 and $10,000,000 against future royalties on oil to be produced, but the king was demanding an additional $6,000,000 per year for 5 years.

The company, through Moffett, proposed that the U. S. Government loan the king $30,000,000, and in return the company would deliver to the Government, for the account of the king, $6,000,000 worth of petroleum products annually for 5 years at 3½ cents per gallon for gasoline, 75 cents per barrel for diesel oil, and 40 cents per barrel for fuel oil. The king would waive the royalty, approximately 23 cents per barrel, on this amount of oil.

Secretary Knox told Moffett that the Navy had no funds sufficient to contract for such a quantity of oil and did not need such quantities in the Persian Gulf area, and also that it had no authority to buy the oil in the ground as a naval reserve. Both Knox and the president told Moffett that the Government had no authority to make a lend-lease or other loan to Saudi Arabia, but they said that Ibn Saud should join the company in a request for assistance.

Later that Summer, Moffett testified, he was in the White House asking Steve Early, the president's secretary, what was done with his proposal when Harry Hopkins, the president's personal assistant, dropped in and remarked that the papers were on the president's personal desk and he would look into it. He later advised Moffett that Ibn Saud was being taken care of in the British loan.

Moffett then inquired of Jesse Jones, head of the Reconstruction Finance Corp., and showed the committee a reply from Jones, dated October 9, 1941, explaining that since

the Government had no authority to loan to Saudi Arabia the president and the secretary of state had suggested that the British do something about it. Accordingly, Jones wrote, he had suggested to the British Ambassador that part of the loan then being negotiated with the British be used for Arabia and that the oil companies might work out some arrangement with the British Government and King Ibn Saud.

Chairman Brewster said that evidence would be presented later to show that the British Government supplied some $20,000,000 to Ibn Saud during this period. Moffett said this was a happy solution to the problem since Ibn Saud got some money from some source and "was kept quiet and proally" and made no further demands on the company.

The later contract under which the Navy is still buying petroleum products from Arabian American and California-Texas Oil Co. has not been placed in the record, though Moffett repeatedly referred to $1.05 per barrel as the selling price. From Navy records the committee staff computed that under this contract the Navy has paid $59,879,594.82, whereas at prices quoted in Moffett's letter to President Roosevelt of April 16, 1941, the same amount of oil would have cost only $26,418,991.15, or a difference of $33,460,603.67.

Moffett, however, estimated that the company has made $68,000,000 profit out of the deal. He also said that in 1941 the company had invested only $27,500,000 in Arabia and has since spent $43,000,000 on a refinery, so that its entire investment of some $70,000,000 has been repaid by its Navy contract.

Many Substitutes for Petroleum Under Research, Western Refiners Told

by Arch L. Foster

SAN ANTONIO.—Several important and abundant substitute raw materials which may replace petroleum when and if the latter becomes scarce are being intensively studied in research to determine how to synthesize liquid hydrocarbons, P. C. Keith, of Carthage Hydrocol, Inc., and an authority on synthetic-hydrocarbon processes, told 500 interested refiners at the meeting of the Western Petroleum Refiners Association March 24-26.

Keith, who is president of Hydrocarbon Research, Inc., outlined the last word in the processes which will start operating soon in plants building or planned in South Texas and Kansas.

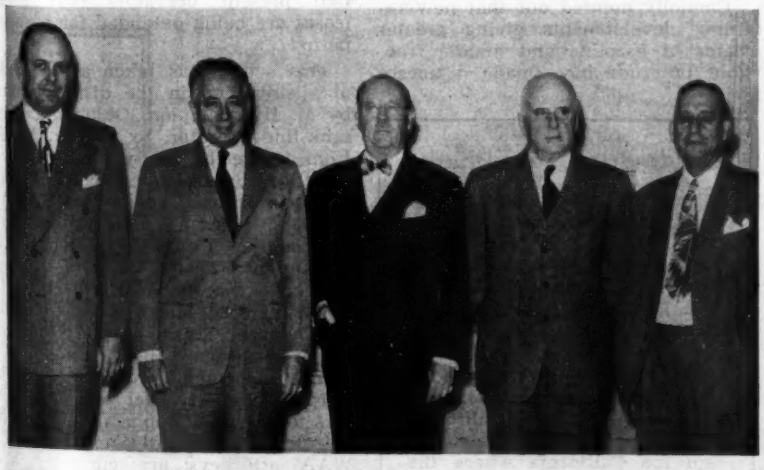
Natural gas is the preferred raw material for synthetic gasoline and oxygenated organic chemicals, Keith states, his company's process requiring some 10,000 cu. ft. of dry gas to produce a barrel of premium-quality motor fuel, according to the best results now obtained.

Keith believes the Hydrocol process can operate on either heavy fuel oil, gas or both at once, to produce synthesis gas, a mixture of hydrogen with carbon monoxide from the decomposition of methane and other light hydrocarbons. This synthesis gas is exposed to temperatures of the order of 600° F. in the presence of a fluid-type iron catalyst to form high-octane-number gasoline with many other products, as naphtha, gas oil, paraffins, and oxygenated products such as alcohols, aldehydes, acids, and ketones.

Ten to 12 cents per 1,000 cu. ft. appears to be about the maximum price permissible in the field for gas for synthesis purposes, Keith said. This limitation encourages consideration of coal for gasification. (For a related story, see page 51). In an analogous manner, heavy fuel oil or tar may be gasified to synthesize hydrocarbons and to relieve the refiner of a troublesome product which may require the addition of lighter material to make it salable. Keith visualizes the Hydrocol type of synthetic-gasoline unit as operating on the "tail ends" of the refinery, waste gases, and tar or fuel oil.

The distillate fuel-oil fraction from this process shows a gravity of 35°-40°, A.P.I., and a cetane number of 50-55, indicating it is satisfactory on those counts. Keith made acknowledgment to Magnolia Petroleum Co., La Gloria Corp., and the Abercrombie interests for "putting up the

Speakers at the W.P.R.A. meeting included Capt. Ralph E. Wilson, U. S. N., who spoke on "Fueling the Navy," and J. K. Roberts, Standard Oil Co. (Ind.), who presented a paper on "Petroleum and Natural Gas — Uses and Possible Replacements." (The Oil and Gas Journal, March 29, page 61)



Officers of the Western Petroleum Refiners Association, photographed at the association's meeting in San Antonio: R. L. Tollett, Cosden Petroleum Co., vice president; R. W. McDowell, Mid-Continent Petroleum Co., vice president; H. T. Ashton, Socony-Vacuum Oil Co., Inc., president; Fayette B. Dow, general counsel; and John C. Day, secretary-treasurer. Not in the picture are T. A. Helling, El Dorado Refining Co., and T. M. Martin, Lion Oil Co., vice presidents

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first money" to carry out research on this process. Later Texaco Development Corp. came into the group and is now licensing it. Other strong research effort has been carried out by Standard Oil Co. of Indiana, and associated companies.

Catalytic Cracking Discussed

Because of the intense and widespread interest in catalytic cracking, a panel of authorities from engineering, research, and refining companies discussed the subject in considerable detail. The discussion included a mass of important operating and product-quality detail of interest to refiners studying these processes.

The oil industry is to be congratulated on the fact that gasoline is the lowest-cost product which is indispensable to American life, said Ernest O. Thompson, chairman of the Texas Railroad Commission in welcoming the refiners to Texas. Texas authorities are determined to stop the flaring of gas—already much has been done in this direction, he said. Conservation of oil has progressed rapidly; already more than two and one-half times as much oil has been drawn from East Texas as was predicted early in its life, and much more is to come, Thompson pointed out.

Another speaker at the meeting was T. H. Risk, Ethyl Corp., Detroit. His paper, slightly abridged, is published on page 78.

The W.P.R.A. board of directors voted to hold the thirty-sixth annual meeting of the association in Galveston, Tex., in April 1948.

The refiners adopted a resolution expressing the association's opposition "to any tax inequalities favoring cooperatives over other types of business enterprise." The resolution declared the association is in favor of "subjecting to the federal income tax those earnings of cooperatives which are available for, but not distributed to patrons in cash as patronage dividends. . . ." It also requested the association's officers to take part in any congressional hearings on the subject.

Secretary of the Interior J. A. Krug told the refiners the petroleum industry and the Government "can in fact work together effectively and harmoniously in furthering the interests of the nation."

One lesson from wartime experience, Krug said, "is that extension of federal control over the petroleum industry, or regimentation of that great industry, is unnecessary and undesirable—that the best over-all job will be done with a minimum of control and a maximum of opportunity for private enterprise to solve our economic problems."

Heavy Demand for No. 2 to Continue, Oil Heat Institute Is Told

ATLANTIC CITY.—Summarizing a study of the heating-oil outlook over the next 10 years, J. W. Connolly, head of the marketing-counsel department of Standard Oil Co. (N.J.), told the twenty-fourth annual Oil Heat Institute convention March 24-26 that kerosene demand, which has been unexpectedly high since the war's end, will rise for a while and then level off. Requirements for No. 2 fuel oil will continue to mount steadily until 1951, when it will slacken somewhat, and No. 6 (residual) will be critically tight, he said.

Currently, inadequate refining and storage facilities will make it difficult to meet demand for heating oils in the near future unless there is full cooperation between every segment of the petroleum and heating-oil industries, Connolly said. The demand for all petroleum products, expected to be 26 per cent greater this year than in 1941, has equalled refinery capacity and exceeded storage capacity, he explained. Because of materials shortage, the oil industry has been unable to add necessary storage facilities and for the same reason most new refineries will not be completed for 2 or 3 years.

Connolly pointed out that new refining developments giving greater yields of gasoline and middle fractions of crude have made it uneconomical for American refineries to get as high a yield of residual fuel as formerly obtained. But, he added, foreign refineries are expected in 2 or 3 years to be processing heavy fuels from Middle East crude to supply European demand which may somewhat relieve the domestic situation.

In a paper on future demand and availability of burning oils, H. M. Hancock, Dr. A. B. Hersberger, and E. T. Knight, Atlantic Refining Co., predicted that 6,200,000 domestic oil burners will be in use by 1955, requiring 250,000,000 bbl. of distillate oils annually, compared to 2,940,000 burners currently using 120,000,000 bbl.

In addition, they estimated 1955 will see 740,000 commercial burners using 90,000,000 bbl. annually, compared to the current operation of 384,000 commercial burners consuming 62,000,000 bbl. They estimated that oil burners used for the heating of homes will increase at an average annual rate of 8.8 per cent.

Pointing toward a lowered quality in burning oils of the future, the authors of the paper predicted larger amounts of cracked oils will be included as the only way "in which motor fuel and heating-oil volume demands can be met." The result, they said, will be burning oils of a lower burning index than those now being marketed.

Crude-Price Tabulation

New crude-oil price postings of major purchasers in the Mid-Continent, Southwest, and Rocky Mountain areas are published in this issue. Gravity schedules are consolidated in convenient tabular form; flat prices of important fields and areas are listed. For the West Coast, the crude-oil price schedule of Standard Oil Co. of California is published in its entirety. Except for California where the new prices were inaugurated March 17, these postings are those effective March 10 with the general price advance. This data appears on pages 119-121.

Veteran's Suit Halts LPG Tank-Car Sale

WASHINGTON.—War Assets Administration has postponed the sale of 423 surplus pressure tank cars, scheduled for April 1, and has notified present operators that their leases are being extended for a short period.

This action was taken as a result of a suit filed in the district court by M. H. Champion, Oklahoma City tank-line operator, to restrain WAA from selling the cars without observing the veterans-preference provision of the Surplus Property Act. Champion, a veteran, obtained several months ago a preference certificate to purchase 250 of the cars. Acting under the Second War Powers Act, which expired March 31, the Office of Defense Transportation ordered WAA to disregard the veterans' preference and other provisions of the Surplus Property Act and sell the cars to specified shippers of liquefied petroleum gas as allocated by ODT. WAA attorneys are currently attempting to decide whether this allocation would be legal if applied after March 31.

Champion has stated that if he obtains the cars he will lease them to LPG shippers.

——— this week

LITIGATION—Shell wins injunction in Texas District Court in Austin preventing the Railroad Commission from carrying out its order drastically slashing Seeligson field production in order to force gas utilization. . . . Commission attorneys indicate they will appeal. . . . ¶Sale of 423 government-owned L.P.G. tank cars by WAA held up as a result of suit filed by Oklahoma City operator who claims agency must follow veterans-preference provisions of Surplus Property Act. . . .

NATURAL GAS—Industry prepares its case in support of the Rizley amendments to the Natural Gas Act for presentation when hearings open April 14. . . . Main fight expected to develop over FPC end-use jurisdiction. . . . Iowa representative introduces bill confirming FPC control over gas utilization. . . .

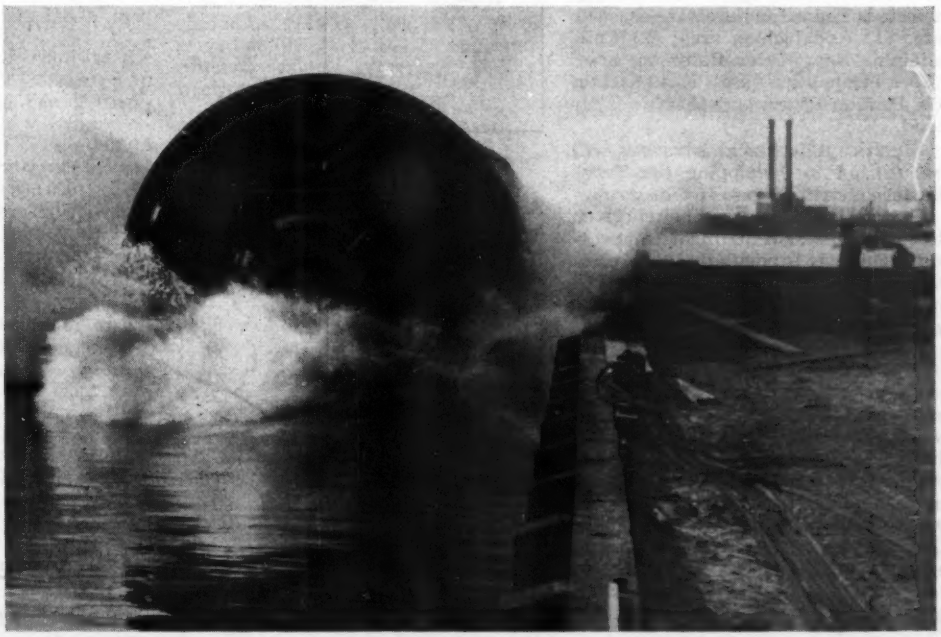
INVESTIGATION—Senate war investigating committee undertakes complete investigation of U. S. Middle East oil interests. . . . Committee retains Burton K. Wheeler, former Montana senator, as special counsel. . . . Inquiry results from charges of James A. Moffett, former Jersey Standard official, that U. S. Navy paid exorbitant prices for fuel oil and other products purchased from Arabian American during the war. . . .

MARKETS—Products market continues to tighten with approach of summer motor-fuel consuming season. . . . A.P.I. officials declare there will be no country-wide gasoline shortage. . . . Heavy inventories and high level of production cited. . . . Some spotty local shortages result in protests to congressmen. . . . ¶J. W. Connolly, Jersey Standard official, tells Oil Heat Institute that fuel oil will be acutely short next winter and that full cooperation will be vital between all industries concerned. . . . ¶South Penn's purchasing agency announces general 10-cent advance for Pennsylvania Grade crudes. . . . Action coincides with final end of U. S. subsidies. . . .

PRODUCTION—Louisiana sets another record allowable for April with permissible production of 452,811 bbl. daily. . . . Oklahoma raises allowable to 378,125 bbl. daily, 8,650 bbl. over March. . . . ¶Oil and Gas Division of the Interior Department and Interstate Oil Compact Commission plan secondary-recovery forum to be held in Washington probably April 28. . . . OGD considers government survey of available production equipment, particularly pipe, in view of continued shortage of some items. . . .

EXPLORATION—East flank well, Monument field, rated 4,944 bbl. 42°-gravity oil, largest 1947 completion in New Mexico. . . . ¶Pure will drill 10,500-ft. test in Andrews County, Texas. . . . ¶Potential field opener in San Jacinto County, Texas, makes 30 per cent water. . . . ¶Barnsdall has third well in Longville area, Beauregard Parish, Louisiana. . . . ¶Ohio Oil Co. test gives Knox pool, Grady County, Oklahoma, a new producing horizon. . . . ¶Leduc field opener, south of Edmonton, Canada, rated 283 bbl. flowing. . . .

INTERNATIONAL—Brazilian company makes plans to begin construction of 10,000-bbl. daily refinery in Rio de Janeiro within next 6 months. . . . Cost is estimated at $10,000,000 with capital provided entirely by Brazilian interests. . . . ¶Chile steps up development work in Spring Hill field. . . . Two more rotary rigs arrive, and fifth test nears completion. . . . ¶Further damage caused to oil-company property by acts of Palestine terrorists. . . .



Too big and too heavy for either rail or barge shipment, this 160-ton tower, 71 ft. in length and with an inside diameter of 23 ft., makes a big splash as it is rolled into Newark, N. J., Bay, preparatory to beginning its long voyage to the Baytown, Tex., refinery of Humble Oil & Refining Co. Fabricated by the M. W. Kellogg Co., the tower was destined to travel some 2,000 miles by inland waterways

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Texas Eastern's Expansion Plans Include New Techniques

by Paul Reed

NOW that Texas Eastern Transmission Corp. is in the process of acquiring the Big Inch and Little Big Inch pipe lines, for $143,127,000, various plans are being considered for converting these systems to natural-gas transmission and extending them to market connections, entailing additional investments of from $38,905,000 to $60,740,200.

This article discusses some of the projects being studied in formulating plans for these huge undertakings. *(For the latest developments regarding operation of the Big Inch system, see Watching Washington, page 47.)*

The general objective is to provide for feeding the Texas Eastern through existing systems rather than to build gathering systems of its own. Toward this end, arrangements are being negotiated with United Gas Pipe Line Co. for obtaining a substantial portion of its supply over a 20-year period. Gas may be introduced into the main lines of Texas Eastern at any of the points of intersection with United's systems as well as at termini of Texas Eastern's main lines.

While it would be possible for any of four great areas to absorb the entire transmission throughput of the Texas Eastern lines, it is regarded to be in the best interests of the nation, of the areas themselves, and of the company that the loads served by these lines be carefully selected. These four areas referred to are: (1) Appalachian area; (2) Philadelphia-New Jersey-Baltimore area; (3) metropolitan New York east of the Hudson River; and (4) New England.

Significant technical advances will be utilized in developing the Texas Eastern's natural-gas system.

Consideration is now being given to experimental centrifugal compressors. There is a possibility that electric-driven equipment of this type may be installed at points along the system in the interim before deliveries of reciprocating compressors might be expected.

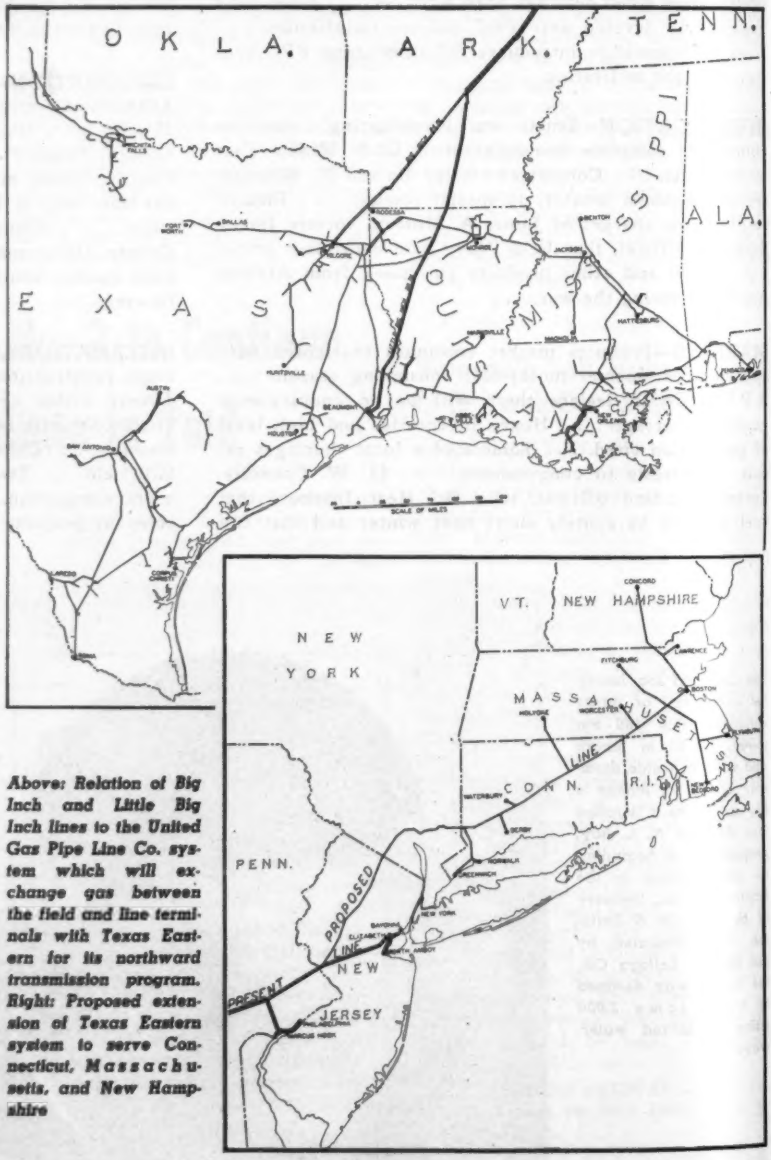
Engineering and economic studies are being made of the problems involved in using the 20-in. Little Big Inch line for shipping liquefied petroleum gas during the summer months when the load on the system would be lowered to a point where this line could be spared from the system for deliveries of L.P.G. to manufactured gas plants in the East which would use these products for gas enrichment.

Eastward transmission of gas produced in Pennsylvania by coal gasification may be undertaken by Texas Eastern within the next 5 years. By that time technical and economic developments in coal gasification may be sufficiently advanced for commercial operation of this kind. Furthermore, the increasing market demand of the Ohio and Appalachian regions promises to absorb a major portion of the Inch lines in the near future.

Already proposals are being discussed for the construction of a 30-in. pipe line by Texas Eastern to parallel the existing Inch lines between the Southwest and northeastern markets.

For transporting gas to the Inch lines from remote points in Southwest, Texas Eastern expects to adopt the unusual plan of feeding such gas into the systems of United Gas Pipe Line Co. and possibly of Arkansas Louisiana Gas Co. This is the first time that such exchange of gas has been planned on a large scale.

Of significance for the future domestic markets to be served by Texas Eastern and other gas pipe lines is the equipment being developed



Above: Relation of Big Inch and Little Big Inch lines to the United Gas Pipe Line Co. system which will exchange gas between the field and line terminals with Texas Eastern for its northward transmission program. Right: Proposed extension of Texas Eastern system to serve Connecticut, Massachusetts, and New Hampshire

for house heating and cooling which would utilize a small gas flame in connection with chemicals. While the amount of gas burned at each of these domestic installations would be small, it is expected that a future extensive distribution of such equipment would result in a steady market.

Plans for converting the Big Inch and the Little Big Inch to natural-gas transmission at rates as high as 425,000,000 cu. ft. daily from the Southwest to East Coast markets are described in a report prepared for Texas Eastern Transmission Corp. by A. D. Greene, chief engineer, United Gas Pipe Line Co. The proposed program includes: looping and weighting of river crossings; installation of additional valves and blowoffs; cleaning, purging, and testing existing lines of the system; construction of additional lines to facilitate distribution, and construction of compressor stations with a total of 147,000 hp.

Cost of Program

The total cost of the program to prepare for serving (1) the Philadelphia-New Jersey area is estimated as $38,905,000. (2) Further extensions to serve also Baltimore would raise costs to $42,205,000. (3) Still further extensions to include the New York areas would increase the total to $56,462,600. (4) A program to serve Philadelphia-New Jersey, Baltimore and New England areas would cost $60,740,200.

In each of these four programs the following identical cost items appear: Conversion cost of main lines, $5,980,000; construction cost of compressor stations, $25,725,000; organization cost, $500,000; interest during construction, $2,500,000, and cash working capital, $3,000,000.

Costs of constructing extensions to distribution systems are as follows: Program 1, $1,200,000; Program 2, $4,500,000; Program 3, $18,757,000; Program 4, $23,035,200.

Existing distribution systems of the two Inch lines are now connected to oil refineries in the vicinity of Chester, Pa., and Linden, N. J. Converting and augmenting the system would cost $1,200,000. A 60-mile, 20-in. extension to deliver 160,000,000 cu. ft. to Baltimore on peak days would cost an additional $3,300,000, raising line construction costs of the Philadelphia-New Jersey - Baltimore area to $4,500,000.

For a possible extension of distribution facilities to New York City and Brooklyn, a tentative 25-mile, 24-in. line would extend from Linden, N. J., to a point across the Hudson River opposite 132nd St., New York City. From there the Hudson River may be crossed by one of three methods: (1) By extending up the west side of the river and crossing the river by having the line suspended from the structure of the George Washington Bridge; (2) by a submarine crossing; (3) by constructing a suspension bridge expressly for natural-gas pipe lines.

An existing tunnel under the East River from New York to Brooklyn can be made available for a natural-gas line.

These extensions just mentioned for the Philadelphia-New Jersey-Baltimore-New York service would involve the following construction: (a) 31 miles of 8-in. at $25,000 per mile, $775,000; (b) 9 miles of 10-in. at $30,000 per mile, $270,000; (c) 9 miles of 12-in. at $50,000 per mile, $450,000; (d) 25 miles of 24-in. at $150,000 per mile, $3,750,000. A Hudson River suspension bridge has been estimated to cost $3,500,000. Construction inside New York City would cost $6,212,600, plus 20 measuring stations at $25,000 each.

If the system is to serve New England, an extension would be built from Lambertsville, N. J., to a Hudson River crossing near the Bear Mountain Bridge and thence northeasterly in a general direction to Boston, with laterals to other cities. This extension, operating with a 5,000-hp. compressor station at Lambertsville costing $1,000,000, would have a capacity of 150,000,000 cu. ft. The New England extension would have 250 miles of 20-in. estimated to cost $13,838,800; 100 miles of 10-in., $2,100,820; and 144 miles of 2-in., 4-in., 6-in. and 14-in., $1,595,570. The entire New England extension project would cost $18,535,200.

A comprehensive study of the natural-gas delivery capacity of the Big Inch and Little Big Inch lines shows that the most economical operating capacity would be between 400,000,000 and 450,000,000 cu. ft. daily, requiring 147,000 hp. at $175 per horsepower, totaling $25,725,000. A typical 7,000-hp. compressor station for the system would cost $1,223,300.

Most of the 24-in., ⅜-in. pipe and the 20-in. 5/16-in. pipe could be operated at 790 psi. in natural-gas transmission service, according to engineering studies.

Summary of Installations

Summary of the existing pipe installations follows:

Diameter	Big Inch, miles	Little Big Inch, miles	Total miles
24-in.	1,253.70	.....	1,253.70
20-in.	104.00	1,477.00	1,581.00
16-in.	10.90	.39	11.29
14-in.	3.53	1.77	5.30
12-in.	15.72	12.67	28.39
10-in.	....	6.39	6.39
8-in.	....	1.41	1.41
6-in.	....	1.42	1.42
Total	1,387.85	1,501.05	2,888.90

Changes in only relatively minor details will be required to adapt the Inch lines to natural-gas service. These will consist of large blowoffs and bypasses for valves to relieve pressure when occasion demands and more complete looping and weighting of submerged stream crossings. Valves now installed would not interfere with gas operations, nor would additional valves, with blowoffs and bypasses, interfere with the operation of the lines as oil carriers in case of an emergency return to oil operations.

The electric motor-driven centrifugal-pump stations have no value for use in gas transmission. These stations may be completely bypassed. Similarly, compressor-station connections would not interfere with oil transportation. Camp facilities and electrical equipment in place at the pump stations will induce the location of future compressor stations close to existing pump stations.

For gas transmission the two lines would be operated as a looped system from Little Rock, Ark., to Linden, N. J. Both lines would be connected at compressor stations and river crossings.

To safeguard against interruptions in service, thirty-one 20-in. loops and thirty 16-in. loops are to be installed.

The estimated cost of cleaning the lines with scrapers and brushes, purging with air and applying a gas-pressure test of 800 psi. is $1,400,000.

Total estimated cost of construction work necessary to convert Big Inch and Little Big Inch lines to natural-gas service:

Looping and weighting river crossings	$3,028,000
Installation of additional valves, etc.	1,284,000
Cleaning, purging and testing lines	1,400,000
Gas used in cleaning, purging, and testing	268,000
Total	$5,980,000

Texas Eastern intends to lease portions of the property which would not be useful for gas-transmission service. However, if none of such equipment should be leased, the company plans to spend a minimum of $215,000 annually to maintain it idle.

Louisiana April Allowable Sets Another New Record

Another new record allowable in Louisiana has been set by the Department of Conservation. April's allowable was pegged at 452,811 bbl. daily, an increase of 5,811 bbl. above the March allocation of 447,000 bbl.

In Oklahoma the Corporation Commission set that state's allowable for April and May at 378,125 bbl. daily, an increase of 8,650 bbl.

Also in Louisiana, Commissioner Joseph L. McHugh approved a daily allowable of 55,000,000 cu. ft. of gas for the H. L. Hunt interest in Lucky field of Bienville Parish. Since the recent action of the state legislature abolishing the state's negative policy toward the export of natural gas, all production control now is vested in the conservation department.

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International

WORLD-WIDE OIL DEVELOPMENTS

Chile's Fifth Spring Hill Field Test Nears Completion

COMPLETION'S of Chile's fifth test in Spring Hill field, Tierra del Fuego Archipelago, is expected shortly. Depth of this well was projected to around 7,500 ft.

Meanwhile, reports from Chile indicate that two more rotary rigs have arrived and that one will be used in Spring Hill field on development work and the other for wildcatting. This will make three rigs operating in Chile.

Very little production data has been available on Chile's oil discovery, owing chiefly to the lack of production equipment. However, the principal characteristics of the oil horizon are:

Depth	7,350-7,500 ft.
Thickness	60-100 ft.
Character of sand	Med. quartz grains
Cement of sand	Anhydrite, clay
Porosity	20 per cent
Permeability	Not determined
Age	Cretaceous or Jurassic
Gravity	43° A.P.I.
Type oil	Paraffinic base
Tubing-head pressure	1,400 psi.
Bottom-hole pressure	3,200-3,400 psi.
Gas-oil ratio	1,000/1 (estimated)
Daily production	500 to 800 bbl. (estimated)

Estimates on proven areas cannot be made, according to E. Simian, head of the mines and petroleum division of Chile's Corporacion de Fomento de la Produccion, who made the above oil-horizon characteristics available in a recent paper presented before the American Institute of Mining and Metallurgical Engineers in New York.

With two rigs operating in the Spring Hill field, it is expected that six more tests will be completed there this year. After this, enough information should be available, Simian explained, to outline the approximate limits of this field.

The other rig, for wildcatting, will be used to resume operations on the mainland. At least two wildcats are expected to be drilled there in 1947.

End of U.N.R.R.A. Leaves Italy Searching for Oil Supplies

MILAN, Italy.—The United Nations Relief and Rehabilitation Administration is about to close down its Italian offices and the question of the oil imports into Italy now faces the Italian Government. The fact has focused once more the attention of the Italian business world and Italian public opinion upon the problem of oil supplies.

In connection with the organization of the oil trade in Italy, there is a tendency to maintain into existence Agienda Generale Italiana Petroli (A.G.I.P.). Other Italian interests are said to be negotiating with The Texas Co. for the creation of a new Italian oil-importing and refining concern with headquarters in Milan and supported by some Italian electric companies interested in imports of oil as fuel. Reports from Rome say an organization has been formed which is in touch with the Petroleos Mexicanos for their representation in the Mediterranean markets. In addition, it is reported that Societa Aziende Petrolifere Riunite Italiane (A.P.R.I.), Milan, has decided to increase its capital from 20,000,000 to 100,000,000 lire to secure participation of Societa Depositi Liguri Olii Minerali operating importing facilities in the Genoa district. The Swiss capital is said to be involved because of an interest in the development of transit of oil through Italian ports.

In Rome, Cooperative Italiana del Petrolio (C.O.N.I.P.) has been formed with the backing of a number of Italian cooperatives. This organization is connected with the decisions of the meeting of the International Cooperative Trading Agency and the International Cooperative Petroleum Association, the secretary of which, Howard Cowden, of the Consumers Cooperative Association, Kansas City, Mo., is said to be supporting the Italian participation in the international association.

Of considerable importance is the question of the quantity of oil and petroleum products to be imported, since this depends on the foreign currency available on the Italian market. The Italian Government is said to have ready a program of oil imports during the second quarter of 1947 to replace U.N.R.R.A. shipments.

During the first quarter of 1947 Italy is expected to receive, on behalf of U.N.R.R.A., a total of 2,000,000 hectoliters (1,260,000 bbl.) of refined products. U.N.R.R.A. also has still to import into Italy 1,100,000 bbl. of crude oil destined partly to the Naples and the Bari refineries which are still in operation and partly to the La Spezia and to the Porto Marghera (Venice) refineries which are to resume activities this month.

The status of the Italian petroleum trade is shown in the accompanying table (figures in barrels):

	U.N.R.R.A. imports Feb. 1 to Dec. 31, 1946	Bimonthly output of refineries from crude imported	1946 consumption	Consumption from Sept. 1, 1938 to Aug. 31, 1939	Percentage of 1946 consumption 1938-1939
Motor fuel	1,858,875	95,000	1,837,441	3,488,745	52.67
Kerosene	1,073,965	42,000	1,198,013	1,330,843	90.00
Diesel oil	1,726,322	119,000	2,094,410	2,256,579	92.81
Fuel oil	5,878,841	90,000	6,081,905	6,600,000	92.15
Crude oil	900,863	.....	.....	.....	....

It should be noted that during 1946 there has been a heavier road traffic than in 1939 owing to the limited efficiency of the railways and that both in railroad and industrial boiler plants there has been a larger employment of oil than before the war. The fact that the total of imports and Italian refinery production during 1946 is smaller than the quantity of diesel and fuel oil actually consumed is due to the fact that the imports refer only to 11 months and to the existence in Italy of stocks created before February 1, 1946.

These results appear to be of considerable importance when it is borne in mind that only in the last part of 1946 it has been possible to place in operation the Bari and the Naples refineries while the other refining plants are still under reconstruction. To what extent the inefficiency of the oil depots has hindered the development of the trade on the Italian market can be understood when it is considered that during the early part of 1946 it was necessary to use the naval coasting station at Taranto to store diesel oil greatly needed in northern Italy.

Prospects Held Favorable On Guasare Concessions

Although prospects appear favorable for both shallow and deep production, considerable development work will be required to determine the true commercial value of concessions held by Guasare Oil Co. in Venezuela.

This comment was made by T. H. Barton, Lion Oil Co. president, in the company's annual report in which he said that Lion in 1946 had acquired a 25 per cent stock interest in Guasare. Oil and gas concessions held by Guasare cover approximately 25,000 acres of the districts of Mara and Paez in western Venezuela, Barton said, and are subject to royalties and overriding royalties. A well capable of flowing about 500 bbl. daily was completed on this property in 1946, and two additional wells were drilling at the end of the year.

Decline Shown in Peru's 1946 Crude Production

Peru's crude-oil production during 1946 totaled 12,455,991 bbl., a drop of 9.4 per cent from the country's 1945 production of 13,748,228 bbl., according to the Office of International Trade of the Department of Commerce.

Production of natural gasoline during the year was 1,041,536 bbl., a decline of 3.9 per cent from the 1,075,137 bbl. produced in 1945.

A. A. Curtice Advocates Hemisphere Oil Policy

The need for a Western Hemisphere oil policy which would assure petroleum supplies in the event of another emergency was emphasized by A. A. Curtice, of Hoover, Curtice & Ruby, in Los Angeles March 26 during the American Association of Petroleum Geologists meeting.

In an interview, Curtice said the United States would be some 1,000,000 bbl. daily short of oil in another war. The integrated hemisphere oil policy he urged included a proposal for a halt in oil exports.

In contrast to the position of the United States, Curtice said reliable reports indicate that Russia discovered 42 new fields between 1939 and 1944, most of them east of the Caspian Sea. With these and supplies from Romania and Hungary, the Soviets, he added, would have ample interior petroleum supplies in case of an emergency.

Curtice pointed to the possibility of further development in South America with its 10,000,000,000-bbl. reserve. As soon as favorable legislation is passed, American companies are ready to spend $100,000,000 on a 10-year program in Peru alone which is calculated to produce 1,000,000,000 bbl. of oil.

Terrorist Violence Damages Palestine Oil Properties

For the second time in less than a month, news reports from Jerusalem state that Irgun Zvai Leumi terrorists have blown up a portion of the Iraq Petroleum Co., Ltd.'s, Kirkuk to Haifa pipe line, near the Haifa terminal.

The first report was denied by company officials at Haifa. The second report states that large fires in the northern outskirts of Haifa broke out following the pipe-line explosion. Iraq Petroleum's other segment of the lines to the Mediterranean terminates in Tripoli, Lebanon.

Three days later reports were published of explosions and huge fires in the neighborhood of properties of Consolidated Refineries, Ltd., and Shell Oil Co. The acts occurred as the British prepared to transfer 1,600 uncertified Jewish immigrants to Cyprus.

Turkey Curtails Rationing

Turkey's rationing of liquid fuels has been removed from all except kerosene, on which the per capita ration has been increased from 1.5 to 3 liters (about 0.4 to 0.8 gal.) per month, according to the Office of Foreign Trade of the Department of Commerce. Lifting of kerosene-ration controls depends upon increased availability of tin plate.

International

Brazil Refinery Project To Start in 6 Months

WITHIN the next 6 months, construction is expected to start on a 10,000 bbl. daily oil refinery in Rio de Janeiro. Completion is expected 18 months after the work gets under way.

Estimated cost is $10,000,000, the capital for which is being provided entirely by private Brazilian interests. Refinaria de Petroleos do Distrito Federal, S.A., is the name of the company. J. P. Salgado Filho is president.

Initially, the refinery will run on either Venezuelan or Saudi Arabian crude or a combination of both. However, the contract giving the company permission to build states that indigenous crude must be used to as great an extent as possible. Moreover, 50 per cent of the refinery's net profit is to be used for exploratory work in Brazil until such a time as it is believed that the country has sufficient domestic production.

At present, A. Baptista Pereira, a member of the board of directors, and Carlos R. Vegh Garzon, consulting engineer, are in the United States to talk with construction companies.

War-Suspended Exploration Being Resumed in India

Exploratory work in India's Sind Province, suspended during the war, recently has been resumed. First, the sandy area around Shaikarpur, about 200 miles north of Karachi, will be surveyed.

United Geophysical Co., of which Herbert Hoover, Jr., is president, is doing the geophysical work. Among Americans in the crew are C. E. Riddell, Randell Riddle, and O. K. Fuller. Fourteen trucks and certain seismograph equipment is being utilized.

India's crude-oil production now averages only 6,900 bbl. daily with 6,000 bbl. of this coming from Digboi field in northeast India. Assam Oil Co., Ltd., is the operator. This company is controlled by Burmah Oil Co., Ltd.

The remaining 900 bbl. daily output is divided between Duhulian field with 650 bbl. and Khaur with 250 bbl. Both fields are in north central India and are operated by Attock Oil Co., Ltd. Joya Mair, another field in this area, is shut in. This field yields a 19°-gravity crude and is said to be one of the most asphaltic crudes found anywhere.

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Postwar view of wells in Ploesti, Romania's most important oil area. Romanian production, in which a joint Romanian-Russian company, Sovrom Petrol, now figures prominently, has shown a continued decline largely because of the lack of equipment for exploratory drilling

Joint Russian Company Dominates Postwar Romanian Operations

by Warren W. Burns

NEW YORK.—Russia's policy of direct economic cooperation with Hungary and Romania, in the form of joint petroleum stock companies, was given considerable attention in the foreign production papers read at the recent anniversary meeting of the American Institute of Mining and Metallurgical Engineers in New York.

The Russian-Hungary oil company, Sovmagnafta, was formed in 1946. The assets Russia supplied to this company included the German oil concession, Manat, seized by the Russians as a Nazi asset, and some other so-called Nazi assets. Hungary contributed the petroleum installations at Malij, the 4,800-bbl. refinery at Szouy and a 15 per cent royalty on crude produced from wells owned by Maort, a Hungarian subsidiary of Standard Oil Co. (N. J.) Proceeds from the refinery and the royalties provide finances for the exploratory and drilling program being carried out now in the Great Hungarian Plain.

Oil production in Hungary started in 1937 and reached its peak in 1943 with 17,600 bbl. daily. In 1944 another field was discovered, but its significance reportedly was small. Current production in Hungary is approximately 13,000 bbl daily. When the Russians leave, it is hoped to reestablish Hungary's crude-oil production on sound field practices. The Russians have been producing the fields at about 2,000 bbl. daily above the maximum efficient rate from American-owned properties which were seized in Lispe field.

Russian-Romanian Partnership

As with Hungary, most important development in Romania since the war has been the formation of the joint Soviet-Romanian Oil Co., called Sovrom Petrol, according to the paper prepared by R. P. Walters, former chief geoologist for Romano-Americana, Jersey Standard affiliate in Romania, and also former petroleum attache for the American Military Mission in Bucharest. This company consists of certain Romanian-owned oil companies and former German-owned companies, the latter being the Soviet contribution.

Of the two so-called German companies, Concordia was Belgium-owned prior to the war and Colombia, French-owned. The legal owners claim their interests were transferred to Germans under duress and they are still endeavoring to reestablish their ownership. Should they be successful, the Soviet contribution to Sovrom Petrol would be minor.

In 1946, Sovrom produced about 24,000 bbl. daily. The daily refinery capacity, however, was rebuilt to 45,000 bbl. Romania entered the war with refining capacity in excess of production due to a drop in output. When Romania joined the Allies, her capacity was dropped due to Allied bombing. In 1944 crude runs averaged 63,000 bbl. daily. Present refining capacity is 140,000 bbl. daily compared with 220,000 bbl. in 1940. Practically all materials used for refinery repairs were salvaged from bombed installations. However, much of the equipment, by U. S. standards, is obsolete.

Production of natural gas during the years 1943-1945 average 18,700,000,000 cu. ft. (This compares with 340,000,000,000 cu. ft. which pipe-line

This article deals with oil activity in Central Europe, Italy, and Brazil. It summarizes papers presented at the seventy-fifth anniversary celebration of the American Institute of Mining and Metallurgical Engineers March 17-19 in New York. A.I.M.E. papers dealing with foreign oil activity in the Middle East and Far East were reported in an article in The Oil and Gas Journal, March 29, page 66.

companies withdrew from the Texas Panhandle in 1944, Walters pointed out).

Development of natural-gas fields in Transylvania continued to expand during the war. Several new fields were found, making nine in all. The new discoveries were at Roua, Zau, and Cetatea De Balta. Gas occurs in many sands in the Sarmatian (upper Miocene). Depth of wells is less than 5,000 ft.

From 1940 to 1943, exploratory drilling expanded appreciably, compared with the prewar period, but from 1944 to 1946 it was virtually at a standstill because of the scarcity of equipment and the desire to use available materials in the development of producing areas.

Peak Output Reached in 1936

Romanian crude production reached a peak of 179,000 bbl. daily in 1936 and by 1940 the decline reached 117,000 bbl. When Romania became a German ally, efforts were made to increase production, but the only tangible result was to hold it to around the 1940 rate. Daily crude production for the past 6 years in Romania follows: 1941, 114,000; 1942, 116,000; 1943, 109,000; 1944, 72,000; 1945, 95,000; and 1946, 86,000.

Since the war, it has not been possible to increase drilling activities in Romania, Walters explained. In 1945, a total of 520,000 ft. was drilled, appreciably less than the prewar average, and this was further decreased in 1946 to 440,000 ft.

Basic reason for Romania's production decline is the lack of new discoveries.

In a recent issue of The Economist, a British publication, it was stated that "the future of the Romanian petroleum industry is still undecided. Despite progress made during recent discussions, the Council of Foreign Ministers has so far failed to agree on the basic issues in the dispute. . . .

"The Russians show no willingness to yield ground and continue to tighten their hold over every phase of the Romanian oil industry's activities. In this climax, both Britain and America, the two powers principally interested in the recognition of legal rights and in the restoration of normal operating conditions, will have to fight hard to establish their claims."

Concerning Romania's probable crude reserves, a recent Reuters dispatch from Bucharest said that the director of the Romanian Geological Institute estimated the total at about 700,000,000 bbl.

Unless Romania obtains badly needed drilling equipment and other equipment, the Bucharest newspaper, Finante Industrie, reports daily production may slip to around 61,000 bbl. in 1948 and 1949.

The agreement between the Romanian and Soviet governments, in establishing Sovrom Petrol, gives the company preferential rights over other companies in which foreign capital participates. For instance, Walters explained, the agreement states that Sovrom—despite Russia's half interest—is to be considered a Romanian company and thus benefits from Romanian laws provided for such companies.

Operations in Italy

In preparing the paper on Italy, C. Wiedenmayer, chief geologist, Societa Petrolifera Italiana, stated that Italy is still not an oil-producing country in an appreciable sense. All the old oil fields are continuing to decline, and some are nearing exhaustion. In the absence of Wiedenmayer, R. P. Walters read the Italian report.

During the war it was impossible to obtain reliable statistical data on drilling and production, and the same conditions still prevail because some of the small companies, mostly for reasons of taxation, do not make any pertinent data available. In fact, the only authenticated information on Italian oil companies comes from Societa Petrolifera Italiana.

While there is no detailed information on over-all drilling, it is assumed that development drilling remained comparatively high in Italy and that wildcat drilling stayed relatively high until 1943.

Since natural gas became a substitute for gasoline in Italy during the war, it is evident that drilling for gas became an increasingly important factor. Numerous shallow wells, from 280 to 400 m. (896 to 1,280 ft.) deep, have been drilled, mostly in the eastern Po plains and at Podelta. This activity was divided among many small operators. Production is restricted to pure methane gas, devoid of higher hydrocarbons.

Larger operations, like Azienda Generale Italiana Petroli (A.G.I.P.), developed Podenzano gas field near Piacenza, now nearing exhaustion. Farther east and something in echelon, the San Girogio-Podenzano field was discovered. However, oil production in these fields is practically negligible.

Wet Gas Discovered

An interesting development, Wiedenmayer pointed out, was the discovery of wet gas on a structure near Lodi (Milan province) which had been found by reflection seismograph. Altogether four wells were drilled, but active operations are still limited to a single (Caviaga 1) gas-producing well from 1,400 m. (4,480 ft.)

Societa Petrolifera Italiana (S.P.I.) discovered two new gas fields in the Ferrara Province with gravimeter data. Bando field was abandoned in June 1946 because the producing sands, in a marine cold-water Quaternary, were not sufficiently well

International

developed. Malalbergo field is still active.

In the course of developing the gas field at Pietramala, in the Tuscany Apennines, close to the water shed, Societa Idrocarburi Nazionali (S.I.N.) found small accumulations of light oil in pockets. Structural conditions here are extremely complicated, and consequently no major development is anticipated. Other smaller operators have developed small and scattered gas fields in the Northern Apennines.

In central and southern Italy, nothing of importance has been discovered. The Bradanic trough, a small Tertiary basin north of Taranto, in which A.G.I.P. drilled three dry holes (near Genzano) has evidently been abandoned as a prospective area.

Sicily saw considerable wildcatting up to 1943 by A.G.I.P., all with negative results. No new developments were reported between 1944 and 1946.

Exploratory activity in Italy is handicapped to a certain degree, Wiedenmayer explained, by the mining law which was not written specifically for oil and gas development. Moreover, an adverse factor during wartime and one which has not yet been overcome, is the difficulty of obtaining adequate drilling tools and other production equipment.

Brazilian Activity

With exploratory, development and wildcatting activities steadily on the increase in Brazil, there is every indication that this South American country may figure more prominently in petroleum production activities in the near future.

For the present, however, actual output remains small, as indicated by the paper prepared for the A.I.M.E. meeting by S. Froes Abreu, chief assistant of Brazil's Instituto Nacional de Tecnologia. In the author's absence, the paper was read by A. A. Curtice of Hoover, Curtice & Ruby.

In 1946, Brazil's crude production totaled only 61,466 bbl., 3.6 per cent more than in 1945. Production is from the Cretaceous or Jurassic.

Data on the fields follow:

Field—	Discovered	Prod. in 1945	Prod. in 1946
Candeias	1942	36,663	47,240
Itaparica	1942	29,222	9,768
Aratu	1942	6,717	4,141
Pitanga*	1946	.....	317
Lobato-Joanes	1941	6,729	.....
Total	....	79,331	61,466

*The small Pitanga field, north of the Reconcavo area, was discovered by seismograph.

Last year's outstanding petroleum

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developments in Brazil were the discovery of more productive wells in Candeias field, such as C-26 with an initial output of 1,500 bbl., and C-28 with an initial output of 1,000 bbl. This encouraged the Conselho Nacional de Petroleo (National Petroleum Council) to such a degree that plans got under way for construction of a 2,500-bbl. daily refinery in Bahia in the Candeias area.

Currently, Joao Carlos Bareto, council president, states that daily production in Bahia is approximately 4,400 bbl., with a total production in Brazil being around 5,000 bbl. daily.

A summary of 1946 drilling follows:

	Bahia basin	Sergipe basin	Parana basin
Wells drilled	14	2	1
Dry holes	1	2	1
Total oil wells drilled as of Dec. 31	44	0	0
Total gas wells as of Dec. 31	13	0	0

Geophysical work is currently being carried on in the area near the mouth of the Amazon River. This work was instigated at the suggestion of DeGolyer & MacNaughton. Field work has been carried on at Marajo Island, and it now seems that a substantial thickness of sediments is present, although the results have not yet been disclosed, Froes Abreu said.

In the Parana basin, United Geophysical Co., S.A., is carrying on survey work around the area west of Ponta Grossa.

Sao Paulo Being Studied

Some geological investigations have been carried on in Sao Paulo preparatory to establishing a drilling program. The Aragua-Lima wildcat well, abandoned several years ago by Companhia Petroleos Brazil, has been deepened by Instituto Geografico e Geologico, a state agency, in order to obtain geological data. This well reached the granite basement at 4,918 ft. and proved the absence of Devonian.

Several survey parties were active in geological and paleontological work in the State of Piauhi in northern Brazil where marine Carboniferous beds have been discovered.

Brazil's mining law is being revised in order to adapt it to terms of the new constitution promulgated last September 16.

In the State of Sergipe, the Industrias Brazileiras Alcalinas drilled for salt and encountered oil and gas shows in the Cretaceous but no production has been obtained to date. Companhia Itatig, which discovered salt deposits in the same area a few years ago, received permission to drill for oil in the adjacent area but has not yet started to work.

Plant Projected to Convert Coal Into Motor Fuel and Gas

PITTSBURGH. — In collaboration with Standard Oil Development Co., Pittsburgh Consolidation Coal Co. has announced plans for a research and development program which is believed will lead to the creation of a new multimillion-dollar fuel industry.

Aim of the program is to perfect commercial processes for making gasoline and a gas fuel of high heat value from bituminous coal. Commercial gasification and liquefaction plants costing approximately $120,000 a unit may result from this project.

Robert P. Russell, president of Standard Oil Development, a subsidiary of Standard Oil Co. (N.J.), said that if the pilot plant for complete gasification of coal operates as expected, the resulting gas could be converted directly into high-octane gasoline, diesel fuels, chemicals, and chemical raw materials by a process which the development company has been working intensively for several years.

Production of gasoline from coal by the development company's synthesis process would result in costs higher than production from crude oil, Russell said, but should this development take place the average motorist could still operate his car at an added cost of not more than 10 cents daily even under present conditions.

Arrangements also have been made for the cooperation of Hydrocarbon Research, Inc., which also is engaged in research on the gasification of coal and production of synthetic gasoline from gas.

Any large-scale production of synthetic oil from coal, comparable to the country's present production of petroleum, would require high capital expenditures and a mammoth construction program which would undoubtedly extend over many years, Russell said.

The fluidized-solids technique, developed originally to improve the quality of motor gasoline, makes possible the production of high-B.t.u. gas and liquid fuels from coal. In transforming coal or coke into gas, the fluid process is used to agitate the powdered coal or coke. The powdered coal, when reacted with oxygen and steam in a generator, forms synthesis gas.

This gas can be treated by the development company's process where, in a reactor using the fluidized technique with a catalyst, the gas can be converted into hydrocarbons. The reaction in this stage liberates a large amount of heat, amounting to 1,800,000 B.t.u. for each barrel of liquid product produced. In the fluid-type reactor, the cooling tubes are immersed in the boiling bed of fluidized solid—an iron catalyst. The rate at which heat is removed is so much higher than in the German type that only one-twenty-fifth the cooling surface is required, it was said.

Presumably the pilot plant will be located at Library, Pa., near Pittsburgh, and will be operating by the end of the year. Arrangements to cover the licensing of any patent which may result from these exploratory studies are now under discussion between Jersey Standard and Pittsburgh Consolidation Coal.

Studies of coal carbonization are being carried out now in a pilot plant located at the Disco plant of the Pittsburgh company. Engineering studies and designs are under way for the second pilot plant.

A commercial plant for making liquid fuels and a high B.t.u. gas, which may be ready by 1950-51, might be located within 25 miles of Pittsburgh, near one of Pittsburgh Consolidation's large coal tracts, according to Joseph Pursglove, Jr., the coal company's vice president. George H. Love, Pittsburgh Consolidation's president, said that the type of plant to be built could turn out gas almost equal to the delivery capacity of the Big Inch system. This is approximately 452,000,000 cu. ft. daily. The plant under consideration would have a capacity of 14,000 bbl. of high-octane motor fuel daily.

Canadian Production in January Shows Increase

January production of petroleum in Canada averaged 19,277 bbl. daily, a slight increase over December's average daily output of 19,177 bbl. The figure was well below the daily average production of 21,946 bbl. recorded in January of 1946.

Truck Movement Increases

Transportation of petroleum products accounted for about 9 per cent of the 2,280,244 tons of freight hauled during January by motor carriers, according to the department of research of the American Trucking Associations, Inc. Use of motor carriers to haul petroleum products showed an increase of 8.2 per cent over December and 21 per cent over January 1946.

WASHINGTON WATCHING

BY HENRY D. RALPH

Middle East Relationships

WASHINGTON. — The Senate investigation of Arabian oil is currently centering around profits made by Arabian American Oil Co. in selling petroleum products to the Navy, but this may turn out to be the least important aspect of the matter.

Involved is the entire subject of relationships between the U. S. Government, American oil and other companies operating abroad, and the governments of countries where Americans have development concessions. Out of it, eventually, may come a definite policy for such activities.

American policy on this subject has been vague and vacillating for many years. Politicians have cringed before the terms "imperialism" and "dollar diplomacy," have hesitated to take a firm stand in defense of an American company in its dealings with a foreign government. In some cases our Government has felt, with justification, that the company involved had unclean hands and that moral right lay with the other side to the controversy. As a result, American diplomacy and commercial enterprise frequently have gone their separate ways, quite in contrast with the British practice.

Chairman Brewster says the problem before his investigating committee is, first, to ascertain our diplomatic commitments and commercial involvements in the Middle East which we are now called on to defend, and, second, to evolve a better working arrangement between the Government and the companies concerned.

Return for Taxpayers?

More specifically, Brewster says that if, as charged, Aramco is making huge profits from sales to the Government although the Government has gone to great expense to protect the company's interests, something should be done to correct this situation for the future. His point is that if the taxpayers must give aid to Greece, Turkey, Saudi Arabia, and other countries to protect commercial enterprises there, then the taxpayers should get some financial return out of dealings with the companies they are protecting.

This same general theme is contained in the O'Mahoney report of the Senate petroleum-resources committee. Now the Senate has before it a specific case to illustrate the problem posed in generalizations in the O'Mahoney report—an American company virtually as rich and powerful as the Government under which it is operating; the need for diplomatic support and financial obligations from the U. S. Government to maintain the concession; and a contract between the company and the U. S. Government which, it is alleged, gives the Government the short end of the stick.

If, as is being said, the "Truman doctrine" of aid to the Middle East is the beginning of a new American imperialism, there should be a clear understanding of the Government's policy vis a vis American companies operating abroad.

Unanswered Charges

CONGESSSIONAL investigations frequently strive for headlines rather than fairness, and the Arabian oil probe is an outstanding example.

Neither the Navy nor the Arabian American Oil Co. has been given a change to answer the charges made against them, though it is reported that when the time comes they will show that the Navy's price for the oil is less than it would have to pay in any other port in the world and that the company's profits are far less than the allegation.

But for headline material the hearings turned up a juicy crop of prima facie scandals. The story has everything. There is oriental intrigue, secret conferences at the White House, the late Harry Hopkins moving quietly in the background, millions of dollars, diversion of a British loan for a purpose not authorized by law, important papers missing from the files.

The only evidence to date has come from James A. Moffett, a former official of some of the companies involved, a man who moved in and out of the Government and had easy access to the White House during the early New Deal days. Only at the close of his testimony was it brought cut for the record that Moffett is suing these companies and some of their officers for some $8,000,000 for fees for his part in the intrigue plus damages for alleged libel. In one suit he seeks $6,000,000 from Arabian American as his fee for seeking government aid during the 1941 financial difficulties of the company and the King of Arabia—the same amount, as one of the senators remarked, as the king was trying to obtain from the company.

Big Inch Operation

THE plan under which Texas Eastern Transmission Corporation proposes to operate the Big Inch and Little Big Inch systems after completing their purchase from the War Assets Administration was revealed in the application for a permanent certificate filed with the Federal Power Commission last week.

Under an interim lease and temporary certificate, effective April 1, the company will continue the present operation of moving natural gas into the Appalachian area to supplement supplies of other distributing systems. It expects to complete purchase on or before November 25, 1947, and asks that it obtain a permanent certificate by that time.

Within 12 months after approval Texas Eastern says it will have installed 24 compressor stations, giving the lines a capacity of approximately 425,000,000 cu. ft. per day, and 66 miles of lateral lines to serve communities in Pennsylvania and New Jersey. Later the company may ask authority to extend service to Baltimore, Md., and areas in New York and New England. *(For other information on Texas Eastern's plans see page 40.)*

Preference for Flare Gas

The company expects to purchase gas at 8 cents per 1,000 cu. ft. delivered to the termini of its lines at 750 psi. It will give preference to flare gas up to at least 25 per cent of its capacity and will pay the same price for flare gas as for dry gas. Texas Eastern will not operate its own production or gathering systems but contemplates a contract with United Gas Pipe Line Co., which has an extensive system through the Texas Gulf Coast area, to furnish up to 25 per cent of the needed gas and to act as a gathering system for much of the remainder. United would buy gas from producers at 8 cents less its own transportation charges, and at times would exchange such gas, taken at remote points on its system, for other gas delivered to Texas Eastern.

Much of this gas would continue to be sold to distributing companies in the Appalachian area on long-term contracts, and the application points out that there is a severe shortage of gas in this area and that the two largest companies bringing in gas, Panhandle Eastern and Tennessee Gas & Transmission, will not be able to fill their demands even on completion of new construction for which they are now seeking authorization.

At the eastern termini of the system, Texas Eastern proposes to build a series of short lateral lines, total-

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ing 66 miles, to serve distributing companies at Trenton, N. J., West Conshohocken, Pa., Chester, Pa., Stations A and B in Philadelphia, Pa., Jersey City, Paterson, and Central Works (near New Brunswick), N. J. The application declares that its natural gas will be used by distributing companies to supplement the product of manufactured gas plants which are now unable to meet all demands and which can be enlarged only with great difficulty under current conditions. The natural gas will be used mainly for reforming and enriching manufactured gas, replacing fuel oil now used for this purpose, and that it will not displace coal to any material extent. The distributing companies are expected to do their own load balancing, but if it is necessary for Texas Eastern to do this it expects to make interruptible contracts with petroleum refineries already connected with the system and now using oil for fuel.

Rubber-Control Extension

CONTINUED operation of most of the synthetic rubber and petroleum-butadiene plants for another year was assured when President Truman signed a congressional resolution just before the March 31 deadline for expiration of the Government's powers over the rubber industry.

The new legislation ends the government purchase and import monopoly on natural crude rubber, returning this trade to private industry, but retains all other wartime controls, including allocation of natural and synthetic rubber and product specification. These powers will assure a market for synthetic rubber even though imports of crude continue to increase.

The resolution continues control until such time as permanent rubber legislation takes effect, but not longer than March 31, 1948. In the meantime, Congress must draft legislation embodying a permanent program for the synthetic-rubber industry, but work has not yet started on this. The administration has recommended that the plants be offered for sale to private industry with assurance that some 250,000 or 300,000 tons of synthetic rubber be produced annually. The interim legislation provides for continued government operation of plants with a total capacity of at least 600,000 tons.

Restrictions written into the resolution in the Senate prohibit disposal of any facility in the rubber program costing more than $5,000,000 until permanent legislation is adopted. Specific exceptions are the neoprene plant, styrene plants, the petroleum-butadiene plant at Toledo, Ohio, two of the three alcohol-butadiene plants, and copolymer plants in excess of the 600,000-ton capacity.

Differences Within FPC

THE deep-seated split in the Federal Power Commission over administration of the Natural Gas Act is pointed up in the second dissenting opinion of Commissioner Leland Olds in the case of the Michigan-Wisconsin Pipe Line Co.

Directly involved is the fight of Panhandle Eastern Pipe Line Co. to maintain its right to continue to serve the Detroit area in the face of the attempt of its chief customer there, Michigan Consolidated Gas Co., to obtain a new source of supply from its own subsidiary, Michigan-Wisconsin.

With Olds writing a strong dissent, joined by Commissioner Claude L. Draper, the commission granted the new company a certificate to build a new line from Hugoton field to Detroit, in spite of Panhandle's objection that this violates its rights under its "grandfather" certificate. Later the three majority commissioners issued a supplemental opinion devoted in large part to criticizing Old's dissent, and now Olds has issued a supplemental dissent blasting his three colleagues.

Olds a New Deal Liberal

Since Olds has a reputation as a New Deal liberal, his motivation may be a desire to strengthen FPC's regulatory powers by preferring regulated monopoly to competition and freedom of contract. But his position in this case coincides with that of most natural-gas companies with exclusive rights to their market areas.

Olds contends that in this case FPC has set a precedent for permitting newcomers to enter gas markets without regard to the investments, ability, and service record of the present supplier. Also, that the commission has made its certificates worthless if they can, in effect, be invalidated by the action of a local distributor in contracting to obtain its supply from a new transmission line.

Panhandle has appealed to the courts but FPC has invited it to ask for a reconsideration before the commission. Such a reconsideration is complicated by the fact that Commissioner Richard Sachse, who sided with the majority, is very ill and may not be able to participate in commission business for some time. This leaves FPC split two to two, and the bitter language used by both sides in the two sets of opinions in the Michigan-Wisconsin case suggests that the commission may be unable to achieve a working majority on important natural-gas-act policies.

Court Sustains Shell In Seeligson Petition

AUSTIN. — District Judge Roy C. Archer early this week enjoined the Texas Railroad Commission from enforcing its order to stop the flaring of gas in Seeligson field.

The temporary injunction was issued on the petition of Shell Oil Co., Inc., which had charged Shell and other operators in the field would be forced to close down operations if the order were enforced.

Shell filed its suit March 24 and was joined in petition by other companies interested in the field. The Railroad Commission had ordered the flow of oil and gas halted until flare gas was used for light or fuel, for chemical manufacturing except that of carbon black, for repressuring, or for extraction of natural gasoline with the residue returned to the producing horizon.

Two Pure Oil Refineries Are Closed by Strikes

Strikes called by the Oil Workers International Union late last week closed the Toledo and Beaumont refineries of Pure Oil Co. A few days before, the Department of Labor in Washington announced the filing of a strike notice by Operating Engineers Local 351 (A.F. of L.) at the Phillips Petroleum Co. plant in Borger, Tex.

A Pure spokesman said the strikes violated an agreement to continue negotiations this week on the union's demands for a master contract to replace plant-by-plant bargaining and a wage increase of 25 cents an hour.

In Fort Worth last week, O.W.I.U. headquarters announced that wage increases from 20 to 25 cents an hour have been granted to two-thirds of the members of the union within the past 3 weeks. Wage controversies settled last week included those with Cities Service Refining Co. and Socony-Vacuum Oil Co., Inc., refineries in East Chicago, Ind., and the Whiting, Ind., refinery of Standard Oil Co. (Ind.).

Pennsylvania Grade Crude Hiked 10 Cents

BRADFORD, Pa.—An increase of 10 cents a barrel in the posted price at all its purchasing points was announced April 1 by the Joseph Seep Purchasing Agency of the South Penn Oil Co.

The increase, coincident with the end of government subsidies, will give producers a higher price than they received under the subsidy plan, the agency said. Other companies, it added, are making a similar raise.

New Seep prices for Pennsylvania grade crude are: Allegany and Bradford oil in Bradford Transit lines and Bradford and Tiona-Sheffield oil in National Transit lines, $3.91 a barrel; Pennsylvania grade oil in Southwestern Pennsylvania and Eureka lines, $3.70; Buckeye oil in Buckeye lines, $3.66.

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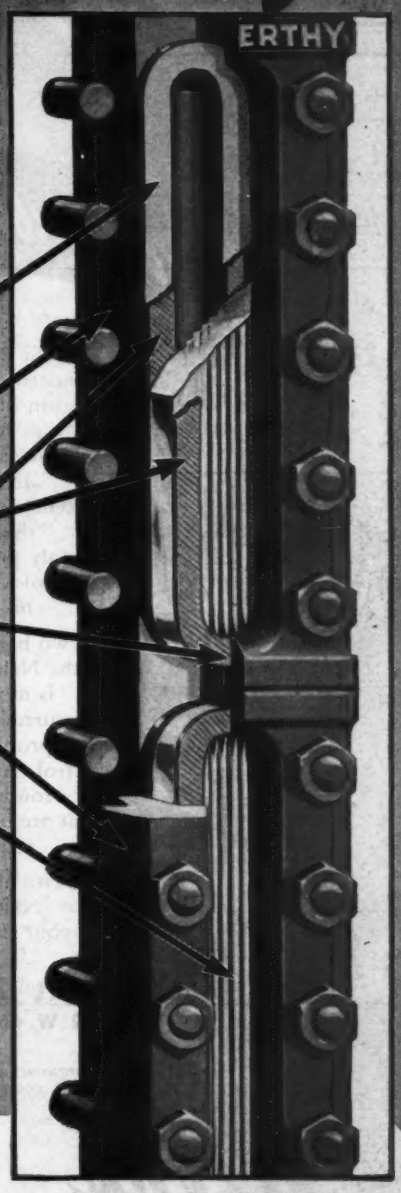

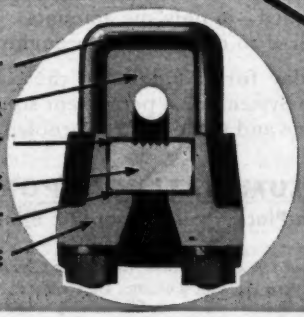

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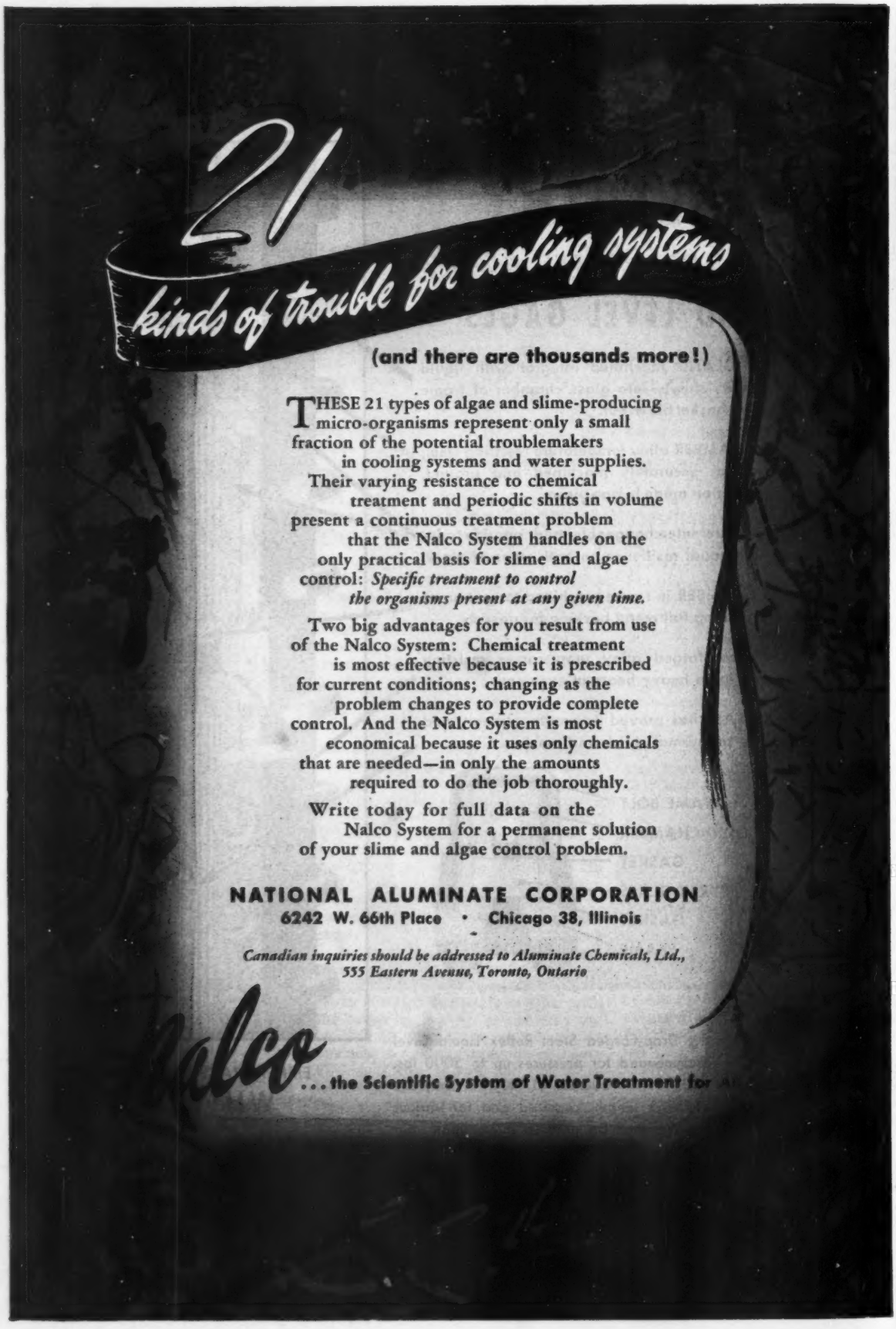
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Newly elected officers of the southwest district, Division of Production, American Petroleum Institute, include, left to right: B. J. Dowd, Union Producing Co., Shreveport, chairman; J. N. Miles, Cities Service Oil Co., Gladewater, vice chairman for East Texas; Roland Gouldy, Bridwell Oil Co., Wichita Falls, vice chairman for North Texas; R. S. Christie, Amerada Petroleum Corp., Fort Worth, secretary-treasurer; and J. S. Boldrick, Humble Oil & Refining Co., New Orleans, vice chairman for South Louisiana. Not shown: J. E. Warren, Carl B. King Drilling Co., Midland, Tex., vice chairman for West Texas and New Mexico; V. J. Martzell, Rosenbloom Pipe & Supply Co., Shreveport, vice chairman for North Louisiana and Arkansas; Jim Teague, Hogg Oil Co., Houston, vice chairman for Texas Gulf Coast; and T. A. Bybee, Gulf Oil Co., Heidelberg, Miss., vice chairman for Mississippi and Alabama

Technical Sessions Conclude A.P.I. Southwest Production Meeting

by George Weber

FORT WORTH.—Two sessions featuring seven technical papers and the election of new southwest district officers marked the second and final day of the American Petroleum Institute Production Division's first spring meeting in Fort Worth March 28.

The slate proposed by the nominating committee and unanimously elected for 1947-48 included: B. J. Dowd, Union Producing Co., Shreveport, chairman; R. S. Christie, Amerada Petroleum Corp., Fort Worth, secretary-treasurer; and seven vice chairmen representing the subdivisions of the southwest district.

A registration of 583 topped last year's attendance at Shreveport by a slight margin.

The opening technical session, at which T. W. Rhodes, Gulf Oil Corp., Fort Worth, and George H. Fancher, University of Texas, presided, concerned secondary recovery and drilling muds. "Case History of Water Flooding in Throckmorton County, Texas," by Paul C. Dean of Dean Brothers, Fort Worth, and the "Inventory of Gas-Drive Operations in North Texas, West Texas, and New Mexico," by L. F. Peterson, Stanolind Oil & Gas Co., Tulsa, and Lee Flood, Goldsmith Pool Engineering Committee, Midland, Tex., will appear in The Oil and Gas Journal, April 12.

The known equations for the flow of plastic fluids were discussed, together with their specific application to drilling mud for various sizes of pipe in the paper entitled "The Flow Properties of Drilling Muds," by three authors: R. W. Beck, Creole Petroleum Co., Maracaibo, Venezuela, formerly with Stanolind, and W. F. Nuss and T. H. Dunn, Stanolind Oil & Gas Co., Tulsa. Laboratory determinations of flow characteristics were compared with actual results of flow tests in the field. The authors conclude that the two constants, yield value and rigidity, which are independent of the size of the pipe through which mud is flowing can be determined with certain types of rotational or funnel viscosimeters.

D. L. Harlan, The Texas Co., Fort Worth, and C. W. Faris, Shell Oil Co., Inc., Midland, presided at the afternoon session. R. W. Stuart, Stanolind Oil & Gas Co., Fort Worth, presented a summary of his company's experiences in "New Developments in Diamond Coring," which concerned work of the past year in Colorado, West Texas and New Mexico. He reported progress in the technique of diamond coring to the point that such bits are being used in regular drilling programs in several areas today. Improved procedures for particular formations, developed with improved bits, have resulted in increased drilling speed, reduced cost, 100 per cent recovery of cores and better completions through more accurate formational interpretation.

A. A. Townsend, Shreveport, and R. H. Smith, Houston, both of Dowell, Incorporated, reported on "Well Completion and Remedial Work with Plastic." Thermo-setting plastics of various types have been used in over 5,000 wells to date. These plastics, available in three grades, for well temperatures ranging from 50° to 350° F., are true fluids which can be introduced into a well as a liquid and subsequently will polymerize into a solid having a hardness comparable to neat cement. Average solidification time is 8 hours.

The two remaining papers of the final session, "Hard-Rock Drilling in the Permian Basin," by David Johnston, Humble Oil & Refining Co., Midland, and "Packer Problems in West Texas," by T. H. Dwyer, Shell Oil Co., Inc., Midland, appear on pages 62 and 92, respectively.

Tax Revenues From Oil Products Show Increase

U. S. taxes on gasoline during February totaled $33,662,334.96, compared with $32,423,441.65 in February 1946, according to a report last week by the Bureau of Internal Revenue.

Revenue from taxes on lubricating oils totaled $8,568,023.03, compared with $5,567,161.69 in February a year ago, and revenue from transportation of oil by pipe line was $2,123,697.30, against $979,122.36 a year ago.

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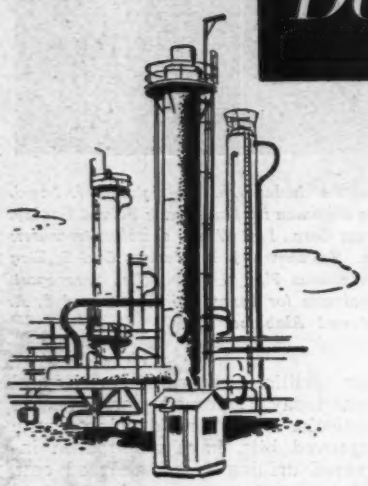

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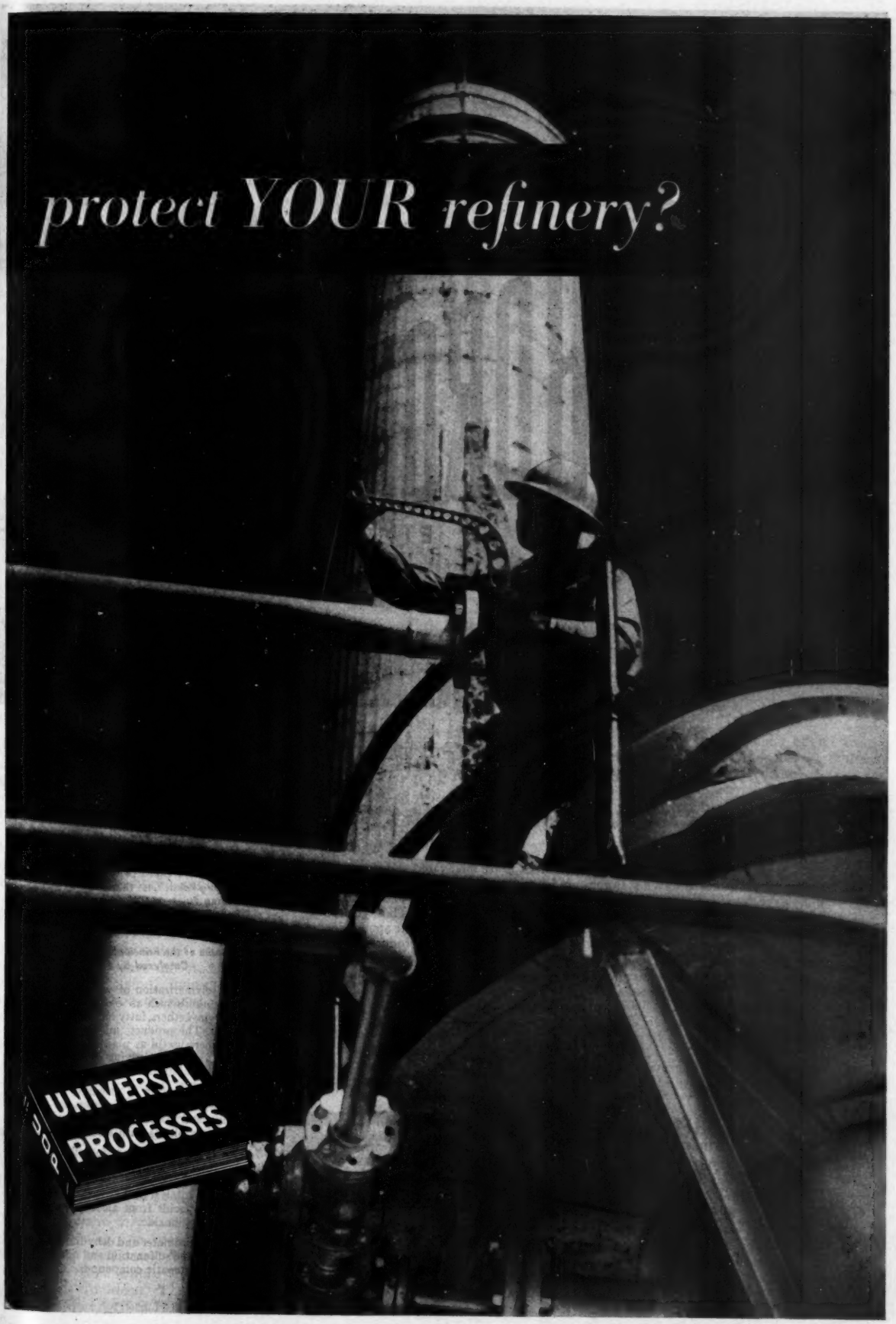
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Physical Properties

Formula:

$$(C_2H_5)_2 > O.BF_3$$

Molecular Weight: 141.9
Melting Point: Less than −60°C
Boiling Point: 125°C
Specific Gravity: 1.14 at 25°C
%BF_3: 47.8% min.

Some of the Principal Reactions Catalyzed by BF_3

1. Polymerization of unsaturated compounds such as olefins, diolefins, vinyl ethers, fatty oils, and terpenes. The products may be solid polymers useful as plastics or liquids as in the bodying of drying oils for paints and varnishes.
2. Condensation of aromatic nuclei with olefins and diolefins, paraffins and olefins, and aromatic nuclei or olefins with acids.
3. As a cyclizing agent for rubber.
4. As an esterification catalyst.
5. As a catalyst in the synthesis of aliphatic acids from alcohols and carbon monoxide.
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BASIC CHEMICALS
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PERSONALS

New Production Chief Is Texas Co. Veteran

A VETERAN of 32 years of service with The Texas Co. is E. R. Filley, who this week was placed in charge of all producing operations of the company east of California.

Filley, who joined the company in 1915 as a clerk in the accounting department in Tulsa, was named to succeed L. E. Barrows, who retired April 1 after 12 years as production manager.

Filley was named clerk of the land department early in 1917. Two years later he was appointed secretary to the general production superintendent of the Oklahoma-Kansas division.

By 1926 he advanced to the post of division superintendent and within the next 3 years he had served as assistant division manager and had been appointed division manager at Tulsa.

He was made assistant manager of the production department at Houston early in 1938, and served in that capacity until his new appointment this week.

The new production manager was graduated in 1915 from Baker University, Baldwin, Kans. Later he studied law at the University of Kansas.

H. G. Brown, production foreman for Shell Oil Co., Inc., has been transferred from McCamey, Tex., to Denver City. Other Shell transfers and promotions include: **T. W. Barron,** junior engineer, from Houston to Midland; **W. N. Brown,** from repairman at the Sheridan cycling plant to engineer-inspector, Magnolia, Ark.; **R. M. Carroll,** junior exploitation engineer, from Conroe to Kilgore, Tex.; **J. W. Crotty,** from district chief clerk and storekeeper, Houma, to division chief clerk, Lake Charles, La.; **P. E. Desjardins,** junior exploitation engineer, from Houston to Midland; and **C. N. Gibson,** from chemist to regional gas-gasoline representative, Houston.

MARK L. TERRY

Mark L. Terry, assistant manager of the Rocky Mountain division of The Texas Co., is being transferred to Tulsa to become assistant manager of the Oklahoma-Kansas division. He is being succeeded at Denver by **H. B. Gernert,** division production and drilling superintendent, who is being replaced by **J. F. Blackwell.**

Frederick A. Gokey, Jr., and **James T. Mullen** have been appointed assistant regional engineers at the Bayway refinery of Standard Oil Co. of New Jersey.

Norman E. Fawley has been named technical assistant in the crude-distillation division of the process department of Baltimore refinery of Standard Oil Co. of New Jersey. **Harry L. Weisman** has been appointed head of the analysis group of the Baltimore laboratory.

William F. Buck, formerly with Carter Oil Co. in Oklahoma City, has joined Superior Oil Co. as a geologist and will be sent to South America.

T. W. Kock has arrived in Bogota, Colombia, to organize exploratory activities for Superior Oil Co. of California. Superior is the ninth U. S. operator to establish headquarters in Colombia.

Nils M. Askman and **Herbert J. Lackey,** members of the engineering department of Standard Oil Co. of New Jersey, have been transferred to Venezuela to assist in the construction of the Amuay Bay refinery of Creole Petroleum Corp. Other department engineers recently assigned to foreign jobs include **Daniel D. Nash** and **Herbert E. Snow,** who have gone to Sumatra in the rehabilitation work on the Palembang refinery.

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W. F. Bramstedt, formerly technical representative on crude-oil sales for Arabian American Oil Co., has been named vice president in charge of crude-oil sales for California Texas Oil Co., Ltd., which is jointly owned by Standard Oil Co. of California and The Texas Co. Bramstedt has been connected with petroleum engineering, refining, and crude-oil sales activities for the last 20 years. During the war, he was in White Horse, Yukon Territory, as project manager of the Canol refinery and pipe-line system.

A. R. Wilson has been named assistant manager of the producing department of The Texas Co., succeeding **E. R. Filley,** who has been appointed manager. Other changes include: **J. N. Troxell,** appointed assistant manager, while retaining his present post as departmental geologist; **L. J. Whetsell,** appointed assistant to the manager in charge of industrial relations; and **J. W. Foley,** transferred from New Orleans to Houston as assistant to the manager.

Ralph Wiggins has been transferred from the Colombia Petroleum Co., where he was chief of the engineering department, to the same position with Socony-Vacuum Oil Co., S.A.

George L. Tyler has resigned as secretary-treasurer of the California Natural Gasoline Association to join

G. L. TYLER

E. R. MILLETT, JR.

the petroleum chemicals division of E. I. du Pont de Nemours & Co., Inc. He will be assigned to the Los Angeles district after a short time in the company's Wilmington office. Tyler is being succeeded by **E. R. Millett, Jr.,** consulting petroleum engineer prior to the war, during which he served as a captain in the Army.

Walker K. Link, manager of International Petroleum Co., Ltd's exploration department, covering Venezuela, Colombia, Ecuador, and Peru, is chief geologist of Standard Oil Co. (N. J.) Link went to Colombia 20 years ago, later being transferred to the Far East and in 1935 returned to the U. S. with Carter Oil Co. In 1937 being transferred to New York as he was named head of Standard Oil Co. of Louisiana's exploration department and in 1940 made a study covering noncommercial producing countries of Central and South America. He returned to Colombia in February 1945.

T. A. Maguire, general manager, Cotton Valley Operators Committee, resigned this week. Following several weeks' vacation, he plans to resume engineering production work in the industry. His successor with C.V.O.C. has not yet been named.

Col. Louis Pineau, president of the Permanent Council of World Petroleum Congresses, London, has been named an advisor on foreign business to Houdry Process Corp. He will maintain headquarters in Paris.

V. C. Georgescu, chairman of the board and general manager of Romana Americana, subsidiary of Standard Oil Co. (N. J.), recently visited Carter Oil Co. properties in Tulsa. Georgescu, prisoner of the Nazis for 3 years, was studying new operational methods and equipment developed during the war. After the end of the war he served for a while as minister of industry, commerce, and mines and during that time formed the Romanian - American Chamber of Commerce and the Friends of the United States Society. He plans to return to Romania in May after visiting Houston and New York.

A. Laird, petroleum engineer with Anglo Iranian Oil Co., Ltd., London, England, is visting oil centers of the southwest, familiarizing himself with the latest developments in production practices. Laird for several years was connected with field operations of Anglo Iranian in southwest Iran.

Joseph N. Pew, Jr., chairman of the board of Sun Oil Co., is the chairman of an executive committee recently appointed to administer policies established by the board and to coordinate the operations of the company. Members are **Robert G. Dunlop,** company president; **S. B. Eckert,** vice president in charge of marketing; **C. H. Thayer,** vice president in charge of manufacturing; and **John G. Pew,** vice president in charge of production.

Greer W. Orton, formerly assistant to the president of The Texas Co., has been appointed general manager

G. W. ORTON

A. M. OTTIGNON

of Texaco's foreign operations, and **A. M. Ottignon,** formerly refinery supervisor of supplies and distribution, has succeeded Orton as assistant to the president. During the war Orton was director of materials division in Petroleum Administration for War. In The Texas Co., Orton succeeds **W. F. Moore** who was recently named president of Arabian American Oil Co.

P. D. Blackburn, Magnolia Petroleum Co., has been made assistant general superintendent of the company's natural-gas and gasoline department. His headquarters will be Dallas. Other Magnolia promotions include **R. H. Illingworth,** Dallas, now in charge of engineering supervision of plant and pipe-line construction, as well as maintenance of plant and pipe-line facilities. **E. L. Stovall,** chemical engineer, is the new head of the Dallas laboratory, with supervision of gas measurement and testing, water and products treating, and plant process control. **H. L. Baker, Jr.,** has been made assistant superintendent of the Vanderbilt district, Vanderbilt, Tex.

Paul D. Barton has been named chief engineer of the manufacturing department of Sun Oil Co., succeeding **Clarence H. Thayer,** recently elected vice president in charge of manufacturing. Barton formerly was assistant manager of the engineering division.

PAUL D. BARTON

SHIFTS—

H. Y. Hyde, superintendent, Tide Water Associated Oil Co., Associated, Calif., to San Francisco; **Robert T. Torrens,** engineer, Chinese Petroleum Co., San Pedro, Calif., to Taiwan, Formosa; **Rae Preece,** superintendent, Hancock Oil Co. of California, Long Beach to San Pedro; **R. B. Dugger,** foreman, Shell Oil Co., Inc., Ventura, Calif., to Los Angeles; **W. L. Harvey,** superintendent, American Drilling Co., West Los Angeles to Saginaw, Mich.; **C. E. Leach,** geologist, Tide Water Associated Oil Co., Los Angeles to Ventura, Calif.

H. G. Johnson, geologist, Standard Oil Co. of Texas, Ben Wheeler, Tex., to Falfurrias, Tex.; **Aaron Cummings,** engineer, Stanolind Oil & Gas Co., South Houston, Tex., to LaFayette, La.; **J. M. Bugbee,** engineer, Shell Oil Co., Inc., Premont, Tex., to Houston; **C. B. Simmons,** engineer, Continental Oil Co., Athens, Tex., to Abilene; **R. E. Vickrey,** engineer, Sun Oil Co., Dallas, to Carthage, Tex.; **William Wood Griffith, Jr.,** engineer, Atlantic Refining Co., Dallas to Odessa.

A. N. Eby, engineer, Superior Oil Co., Houston to Bellaire, Tex.; **S. P. Weatherby,** geologist, Southern Minerals Corp., Houston to Corpus Christi; **H. V. Anderson,** superintendent, Cities Service Oil Co., Pampa, Tex., to Liberal, Kans.; **William L. Cain,** engineer, Phillips Petroleum Co., Phillips, Tex., to Odessa; **Wayne R. Bright,** engineer, Stanolind Oil & Gas Co., Wink, Tex., to Brownfield, Tex.; **Gordon T. Lepley, Jr.,** engineer, Atlantic Refining Co., Magnolia, Ark., to Odessa.

Lawrence P. Layman, engineer, Shell Oil Co., Inc., White Castle, La., to Donaldsonville, La.; **William C. Maher,** engineer, Stanolind Oil & Gas Co., Jennings, La., to Alvin, Tex.; **K. G. Kugler,** engineer, Standard Oil Co. (Ind.), Chicago to Cleveland, Ohio; **George F. Bauer, Jr.,** engineer, Sharples Chemicals, Inc., Chicago to Tulsa; **Edward Clymer,** engineer, Tide Water Associated Oil Co., Elizabeth, N. J., to Bayonne, N. J.; **M. J. Lynch,** engineer, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J., to Woodbury, N. J.; **Hugh D. Sims,** engineer, Magnolia Petroleum Co., St. Bernard, Ohio, to Cincinnati.

I. H. Hughes, engineer, Phillips Petroleum Co., Bartlesville, Okla., to Oklahoma City; **Carl V. Fryer,** engineer, Champlin Refining Co., Enid, Okla., to Cyril, Okla.; **William R. Franey,** engineer, Stanolind Oil & Gas Co., Wewoka, Okla., to Oklahoma City; **A. F. Haber,** geologist, Continental Oil Co., Anadarko, Okla., to Clinton, Okla.; **J. W. Richardson,** foreman, Amerada Petroleum Corp., Hobart, Okla., to El Dorado, Ark.

Varied Program Scheduled for N.P.A. Meeting April 17-18

PROBLEMS and developments in refining processes, industrial relations, and transportation will highlight the forty-fourth semiannual meeting of the National Petroleum Association, to be held in the Hotel Cleveland, Cleveland, Ohio, April 17-18.

Group meetings, including a meeting of the executive committee, will be held Wednesday, April 16, preceding the opening of the event.

The program follows:

THURSDAY, APRIL 17

10 a.m.—Department of traffic and transportation, round table, "Role of Private Carrier in Our National Transportation Program," B. Y. Blanning, director, Bureau of Motor Carriers, Interstate Commerce Commission. Department of manufacture, Joseph E. Keller, attorney and department secretary, presiding. "Phillips Cycloversion for the Smaller Refinery," M. W. Conn, manager, chemical-products department, Phillips Petroleum Co., Bartlesville, Okla.; "Straight Run Answers the Burning Question," J. C. Martin and C. H. Van Hartlesveldt, Atlantic Refining Co., Philadelphia, Pa.; "Effect of Temperature in T.C.C. Catalytic Cracking," H. D. Noll, R. E. Bland, and G. Kelso, Houdry Process Corp., Philadelphia; "Stop-Gap Processes Versus Catalytic Cracking," David Read, Universal Oil Products Co., Chicago. Department of industrial relations, Donald C. O'Hara, attorney, presiding. "Operation of a Wage-Incentive Plan in Petroleum Refining," William H. Brush, industrial engineer, Atlantic Refining Co., Philadelphia.

2 p.m.—General session. President's welcome, J. B. Fisher, president, National Petroleum Association; "Future Economic Trends," John D. Clark, member, President's Economic Council, Washington; "The Outlook in Labor Relations," round table conducted by Thomas G. Patton, general counsel, Republic Steel Corp., Cleveland; Donald C. O'Hara, attorney, National Petroleum Association, Washington; and J. W. Rees, personnel director, Pure Oil Co., Chicago.

FRIDAY, APRIL 18

10 a.m.—General session. "Foreign Petroleum Refining," C. J. Bauer, Standard Oil Co. of New Jersey, New York; "Activities of the Oil and Gas Division," Max W. Ball, director, Oil and Gas Division, Department of the Interior, Washington; "Our National Transportation Policy," Dr. John H. Frederick, professor of transportation, University of Maryland, and special counsel, House interstate commerce committee, chairman. Discussion leaders, all from Washington, will be: Railroads—Robert S. Henry, assistant to the president, Association of American Railroads; water—Chester C. Thompson, president, American Waterway Operators, Inc.; air—Stewart G. Tipton, general counsel, Air Transport Association of America; highway—Roland Rice, general counsel, American Trucking Associations, Inc.; and pipe lines—Fayette B. Dow, general counsel, N.P.A.

Eastern A.P.I. Meeting to Open April 16

Secondary-recovery problems of the eastern oil industry will be given close attention at the spring meeting of the Division of Production of the eastern district of the American Petroleum Institute. The meeting will be held in the William Penn Hotel, Pittsburgh, April 16-18.

Opening day will be devoted to meetings of committees and subcommittees, with the opening general sessions scheduled for 10 a.m. Thursday, April 17. A series of technical sessions will follow.

Following is the preliminary program:

THURSDAY, APRIL 17

10 a.m.—General session, R. B. Anderson, Columbian Carbon Co., Charleston, W. Va., presiding. Remarks, Jake L. Hamon, vice president, American Petroleum Institute; "A National Oil Policy and Its Effects on the Domestic Petroleum Industries," B. A. Hardey, president, Independent Petroleum Association of America, Shreveport; "Progressive Public-Relations Program for the Progressive Petroleum Industry," Franklyn Waltman, public-relations department, Sun Oil Co., Philadelphia.

2 p.m.—Technical session, John Askam, Ohio Oil Co., Findlay, Ohio, presiding. "Recent Advances in the Problem of Oil Origin," William Hanson, senior fellow, Mellon Institute, Pittsburgh; "Water-Flooding Research Is Essential," David Scott, Ryder-Scott Co., Bradford, Pa.; "Connate and Drilling-Water Saturation of Baker Cores," A. P. Clark, South Penn Oil Co., Bradford, Pa.; "Recent Advances in Selective Exclusion of Water in Input Wells," Don Martin, Hercules Powder Co., Wilmington, Del.; Kurt H. Andresen, South Penn Oil Co., Bradford, Pa.; and F. W. Ellenberger, Kendall Refining Co., Bradford, Pa.

FRIDAY, APRIL 18

10 a.m.—Technical session, Virgil Bowyer, Peoples Natural Gas Co., Pittsburgh, presiding. "Design of Long-Distance Natural-Gas Transmission Lines," R. G. Strong and T. H. Beals, Natural Gas Pipe Line Co. of America, Chicago; "Potential Natural-Gas Market of the East," James E. Pew, manager, natural-gas department, Sun Oil Co., Philadelphia; "Some Economic Factors Affecting the Natural-Gas Supply of the Appalachian Region," Alden Foster, petroleum engineer, Pittsburgh; "Effects of Increase in Water Pressure on Water-Flooding Oil Production," Harry M. Ryder, Washington.

2 p.m.—Technical session, Kenneth Cottingham, Ohio Fuel Gas Co., presiding. Eastern district A.P.I. business meeting and election of officers; R. B. Anderson, general chairman, presiding. "Practical Aspects of Drilling the Clinton in Ohio," James F. Swain, Huntley & Huntley, Pittsburgh; "Rotary-Tool Drilling in Ohio," Noah Andrews, Union Drilling & Producing Co., Mt. Pleasant, Mich.; "Underground Gasification of Coal," L. D. Schmidt, Synthesis-Gas Production Laboratory, U. S. Bureau of Mines, Morgantown, W. Va.

BEGINNING in this issue the personals pages of the Journal, which have hitherto been appearing just ahead of the classified advertising, will be found in the fore part of the magazine, following the Watching Washington feature, thus becoming part of the news section. Statistics and Trends are now found where the personals formerly appeared. These pages are followed by the weekly market discussion, which has been expanded to include highlights of the week's market quotations for representative products, including lubricating oils. These changes have been made in the interest of better editorial arrangement.

DEATHS

Charles C. Herndon, associated with Tube-Turns, Inc., and before 1926 assistant superintendent of the Transcontinental refinery in Bristow, Okla., died March 29 in a Houston hospital.

William H. Cullen, 68, formerly associated with Wentz Oil Co. and prior to 1931 an engineer with Oklahoma Natural Gas Co., died March 22 in Ponca City.

H. A. Dennis, 40, Louisiana oil operator and resident of Lafayette, La., died at Jennings, La., March 25, from injuries sustained in an automobile accident.

S. Clyde Kyle, who developed the Pelton jack, used for hydraulic pumping of oil wells, died recently in Bakersfield, Calif. He was associated with Pelton Water Wheel Co.

Columbus M. Joiner, 87, whose wildcat, Daisy Bradford, drilled in 1930, became the discovery well of East Texas field, died March 27 in a Dallas hospital. Joiner drilled his first well near Seminole, Okla., in 1913 and in following years became famous as one of the most colorful figures in the oil industry.

Victor C. Mieher, 63, attorney for Amerada Petroleum Co., died March 27 in a Tulsa hospital.

J. H. Grundish, 72, retired independent producer and drilling contractor, died March 28 in Tulsa. Grundish in 1914 drilled the discovery well in a McIntosh County, Oklahoma, pool. In 1917 he was superintendent in Wyoming for Prairie Oil & Gas Co.

Carthage Engineers Fight Hydrates

by George Weber

HYDRATE plugging of gas-gathering systems in Carthage has been the field engineer's biggest operating problem this past winter. Trouble, arising from a variety of causes, struck at practically every system in the big gas field and the corrective and preventive measures which engineers have undertaken should add considerably to the technique for combating hydrates in high-pressure gas lines.

Carthage now covers a productive area nearly 25 miles in diameter. Gas must travel long distances in some of the more extensive gathering systems before reaching extraction plants. Line distance from the farthest well to the plant in one major system is 18 miles. In nearly all systems, total production is carried in the lines; not only gas but liquid condensate in amounts varying with pressure from about 10 to 25 bbl. per M.M.c.f. plus water averaging about 6 or 7 gal. per M.M.c.f.

Some systems, designed for future loads, have been operating at partial capacity during the field's development stage, and low flow rates have contributed to line plugging. High operating pressures maintained in some of the gathering lines elevate the hydrate point considerably above the normal winter ground temperatures and an unusually cold, wet

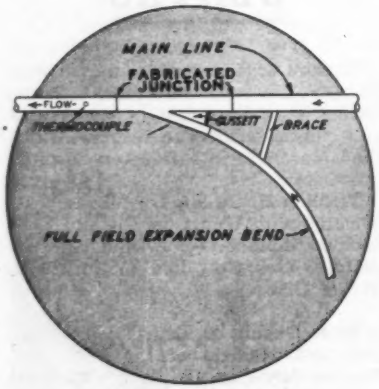


Fig. 1—Streamlining of lateral tie-ins to main gathering lines to reduce turbulence and hydrate formation at Carthage. Small-angle "T" is fabricated as a unit and welded into the line

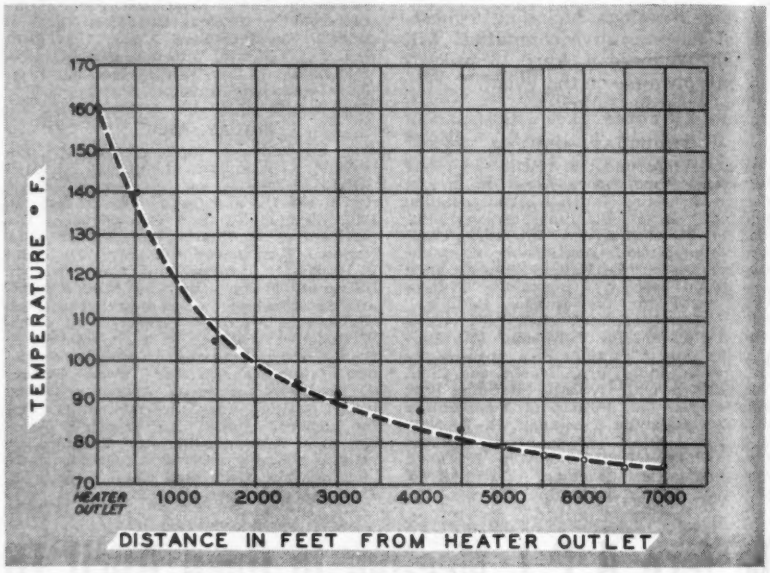


Fig. 2—Typical temperature gradient in Carthage 8-in. gathering line: combined gas and liquids, ground temperature 43° F., flow 12½ M.M.c.f. per day, line pressure 930 psi.

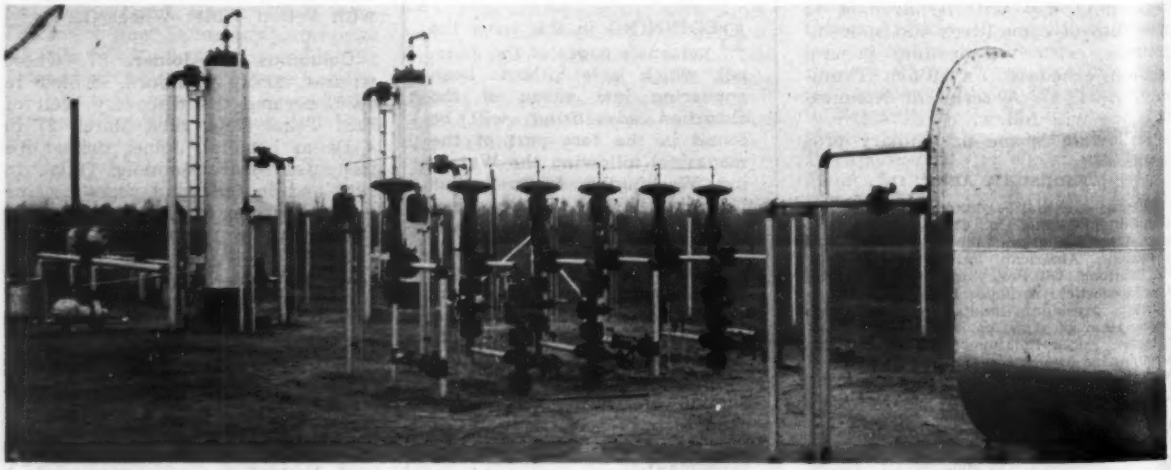


Fig. 3—Well installation shown graphically in Fig. 4. Left to right: line heater, meter runs, separators, regulators, and well heaters

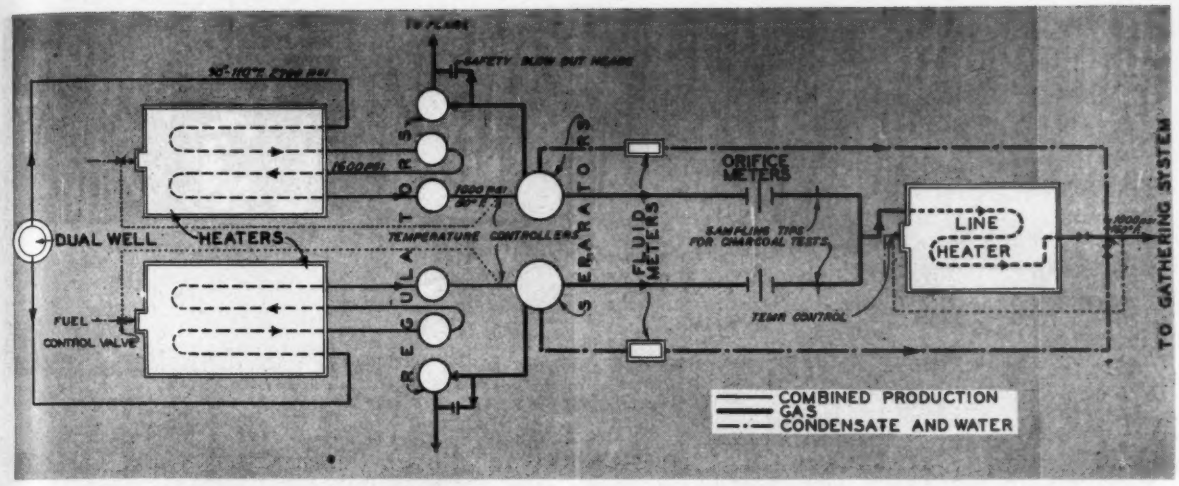


Fig. 4—Three-heater dual-well installation providing controlled temperature and flow

winter increased that temperature differential. Thus faced with numerous factors promoting hydrate formation, operators have been hard pressed during cold spells to maintain record gas deliveries from field wells.

During the past few months the principal concern of operators has been to minimize hydrate stoppages as much as possible by rapid location and removal of plugs. Important preventive work is now under way, and this long range program, plus the probability that producing and gathering schedules will be better organized before another winter, indicates a partial solution to the problem before late 1947.

Well-head gas temperatures under normal flow rates average 110°-130° F. before reduction to line pressures. Well-head pressures vary up to 3,000 psi. A number of weak wells exist in both the Upper Pettit and Lower Pettit wells, which comprise the bulk of field producers. These wells, with bottom-hole pressures as low as 1,420 psi., govern in some cases the operating pressures for gathering systems. Gathering-line pressures in the field range up to 1,500 psi. and sometimes higher. The presence of condensate and water in liquid form apparently does not appreciably affect the hydrate formation at Carthage, since hydrates form at temperatures and pressures indicated for gases between the gravities of 0.6 and 0.7 on the Katz chart.* This required a high temperature, about 70° F., to operate free of hydrate trouble in a 1,500-psi. system.

Preventive Measures

As a final solution to hydrate stoppage, installation of heaters at wells and along main field lines will be necessary in the larger systems. The degree to which added heat is necessary depends on many factors in system design. Where possible, gathering systems have been designed to minimize if not eliminate hydrate formation. High flow rates are desired, not only to carry gas further before it cools to the hydrate point, but to keep low points on main lines swept clear of liquids. Line freezing has been prevalent in low spots where insufficient velocity allowed liquid accumulation. In cases where such liquid slugs were swept out periodically by increased loads, hydrate trouble occurred on the downstream side of the dips.

Systems designed for predetermined capacity are graduated in size to provide for uniform pressure drop and avoid turbulence. Some operators have adopted 4 and 6-in. laterals in preference to smaller sizes to reduce pressure differentials at lateral tie-in points. Full sweep is given line bends, both vertical and horizontal to promote streamlined flow. The turbulence arising from right-angle junctions of laterals with main lines has been eliminated in one well-designed system by use of fabricated streamlined junctions. (Fig. 1). Laterals are joined on a full field bend both to avoid turbulence and to provide for line expansion. Burrs, weld-

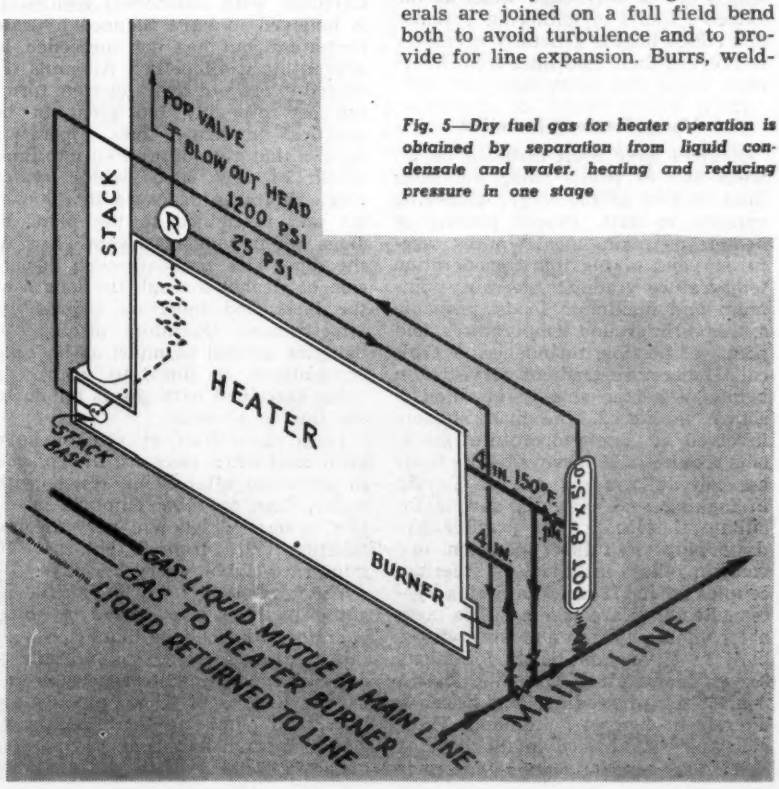
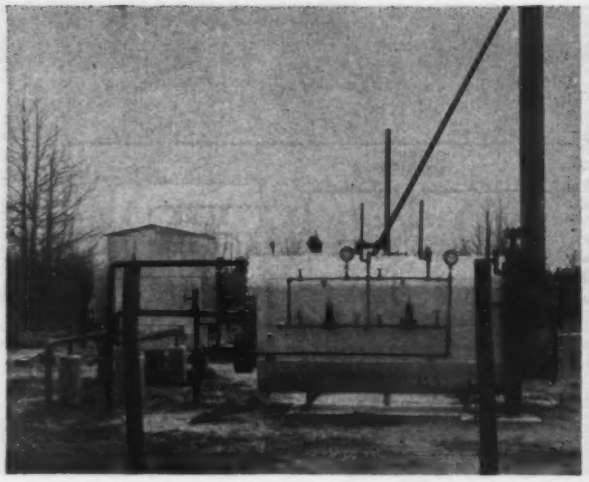


Fig. 5—Dry fuel gas for heater operation is obtained by separation from liquid condensate and water, heating and reducing pressure in one stage

*"Prediction of Conditions for Hydrate Formation in Natural Gases," by D. L. Katz, Petroleum Technology, July 1944.



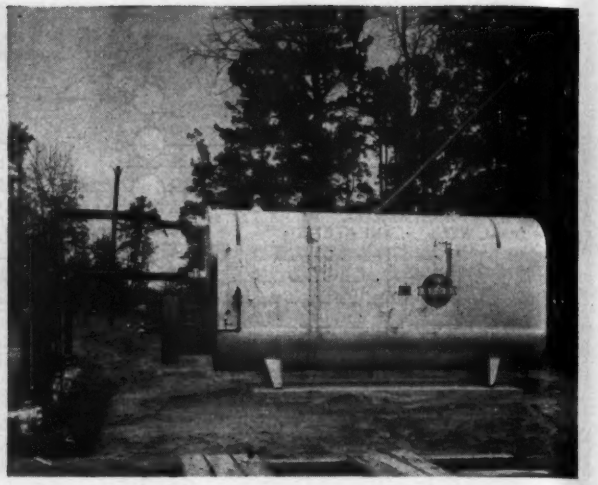


Fig. 6—(Left) This well heater takes fuel gas from mixed production, passes two knockout vessels and is reduced to proper burner pressure in stages. The gas is heated in the water bath between stages. Fig. 7—(Right) Line heaters are installed at high points on main lines to avoid liquid accumulation immediately ahead of the heater inlets. The fuel-gas system for this heater is shown graphically in Fig. 5

ing icicles, and other inside obstructions in lines have been removed in some systems by knife scrapers followed with steel brushes, reducing turbulence and localized hydrate formation.

Weak wells in the same system with high-pressure producers are a cause of much trouble, since they tend to load with condensate and "float" on the line, when the system pressure equals their well-head pressures. Flow velocity is low from these wells, which are usually edge wells at the extreme limits of gathering systems, and added heat is generally necessary to prevent their lead lines from freezing.

Many Heaters Installed

Heaters have been installed on all wells and at points along the main lines in two of the larger gathering systems to date. Proper placing of heaters on main lines requires careful surveys, taking into consideration temperature gradients, terrain, minimum and maximum loads, probable extremes in ground temperatures, and points of possible turbulence. A typical temperature-gradient curve taken behind a heater already installed is shown in Fig. 2. The many factors involved in line-temperature gradients require field surveys before heaters can be properly placed. To aid in making such surveys, and to facilitate the location of possible hydrate plugs in future operation, one company has installed 94 thermocouples in its 18-mile gathering system. Readings are taken with a portable potentiometer employing an ice bath in a vacuum bottle for fixed, known temperature. Once the instrument is zeroed, readings may be made directly in degrees Fahrenheit. Thermocouples are placed in the lines at 300, 500, and 1,000-ft. intervals downstream from all wells, dips, bends, and junctions, and at 1,500-ft. intervals elsewhere in the system. This installation was used in placing line heaters in the system, and continued surveys will prove useful in studying future temperature gradients and the relationship between ground and line temperatures in different sections of the field.

Alcohol Use Limited

Alcohol injection has been used at Carthage with indifferent results. It is believed to have reduced hydrate formation, but has not succeeded in preventing it altogether. Amounts required to prevent hydrates from forming are probably too great to be practical in many lines. Operators believe that alcohol injected into lines ahead of low spots where water forms, becomes dissovled in the water and is carried to the plant in slugs when water is swept clear of the dips. This prevents even dispersion of alcohol through the length of the lines, and therefore reduces its effectiveness. Operators attempt to vaporize alcohol as much as possible on addition to lines, to insure its being entrained with gas as far down the line as possible.

Large quantities of alcohol have been used when lines are first placed in operation after being tested with water. One operator employs injection devices which will vary alcohol addition rates from 1 bbl. per 10 minutes to 1 bbl. every 2½ days.

Water removal from low points in gathering lines is practiced by some operators who believe that it reduces line freezing to some extent. This is done by connecting storage legs comprising lengths of 24-in. pipe below lines, and emptying them regularly. One company has gone further in installing dual gravity drips at all low points, automatically dumping water but not condensate. These measures have reduced but not eliminated water, and sufficient water vapor carries over to permit hydrates to form downstream. Partial removal of water is helpful, however, in allowing more effective use of alcohol and preventing the slugging of water in lines.

Heater Installations

Where possible, operators prefer to reduce gas to operating-line pressure before heating at the well, in order to avoid the cooling effect of expanded gas behind the heater. Well installations range from simple shop-made heaters on well line jackets, to the completely automatic installation illustrated and shown graphically in Figs. 3 and 4. In that installation, effluent from the dual well is handled in parallel systems throughout the two-stage pressure reduction, heating, and separation, and gas from the two horizons is combined in a third heater which controls line temperature to the gathering system. Separator inlet temperatures are held at 80° F. by thermostatic control on the heater fires. Liquid and gas are metered separately and recombined behind the line heater which brings gas temperature to a controlled 160° F. Gas production is maintained at a selected rate by means of a recorder controller. This regulates flow through the second regulator according to a selected pressure differential across the plates in the orifice meter. Each separator is equipped with a blowoff line.

Both well and line heaters take their fuel from the high-pressure mixture of gas and liquid, and require special equipment to maintain an even flow of dry gas at low pres-

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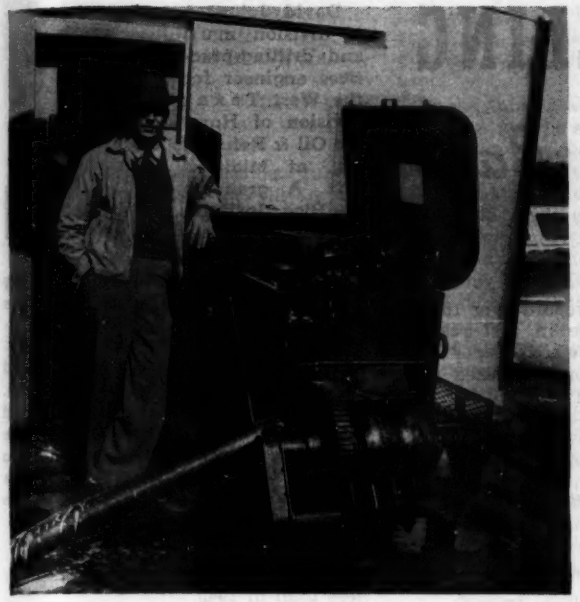


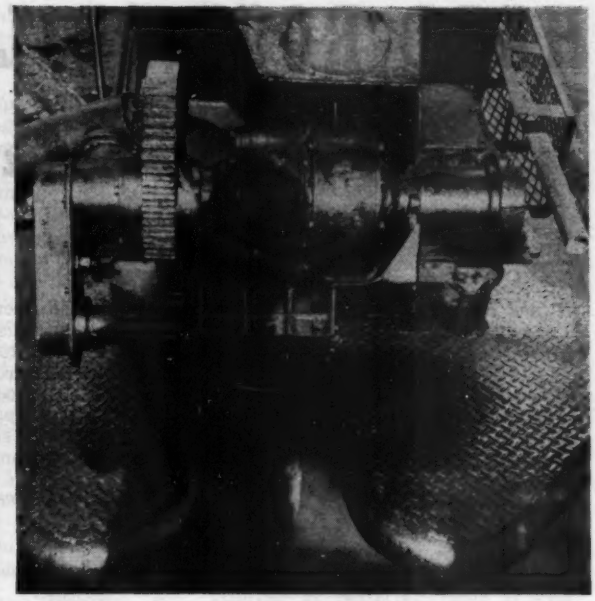


Fig. 1—(Left) Murray-Trigurtha propelling unit. Troy Maxwell, Gulf engineer, explains ease of maneuvering barge with outboard-motor style unit. Barge speed is approximately 10 m.p.h. Fig. 2—(Right) Closeup of 4 to 1 reduction unit and wheel shaft

Recent Innovations in
LEASE WORK BARGES

by E. H. Short, Jr.

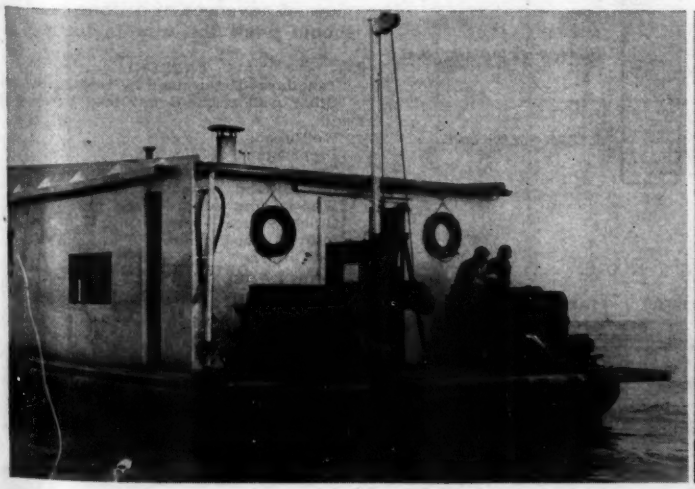
ONE of the most important lease-operating problems in the fields off the shore of the Mississippi delta is that of maintaining paraffin-free tubing strings and lead lines. About 2 years ago Gulf Refining Co. increased the efficiency of this type of work by placing a number of work barges in operation which were specially designed to service approximately 120 wells in Quarantine Bay, West Bay, and Grand Bay fields.* These barges are each equipped with paraffin-scraping tools, measuring line, coil-type steamer (which develops a full head of steam in 3 minutes) and fire-fighting equipment. Two sizes of barges are now in use. The largest size, which is 60 ft. long, 20 ft. wide and 5 ft. deep, is used in the rough waters of Quarantine Bay. A somewhat smaller size of barge is 45 ft. long, 16 ft. wide, and 4 ft. deep. Tug boats were used in getting the work barges to well locations in the various fields.

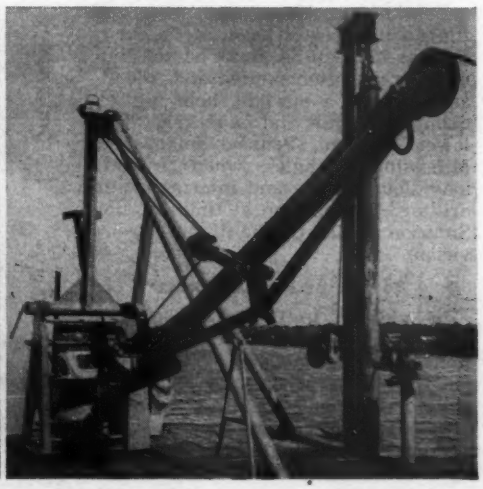
Recently Gulf made two major improvements in work barges which further increased operational efficiency in this type of work and also effected a reduction in the cost of

(Continued on page 100)

*The Oil and Gas Journal, April 28, 1945.

Fig. 3—(Left) Large work barge used in rough waters of Quarantine Bay area equipped with two units. Fig. 4—(Right) Gulf-type winch and boom installed on pipe-line work barges. Extension may be provided to give 35-ft. reach from base





HARD-ROCK DRILLING

In the Permian Basin

by David Johnston

David Johnston is division mud and drilling-practices engineer for the West Texas division of Humble Oil & Refining Co., at Midland, Tex. A graduate of Rice Institute of Houston with a B.S. in chemical engineering, he joined Humble in May 1944 in the drilling-practices section of the petroleum engineering division, following his return from service with the Army. He was appointed to his present position in July 1945.

This article is a slightly abridged version of a paper presented at the spring meeting of the Southwestern district of the American Petroleum Institute's Division of Production in Fort Worth, March 27-28.

IT has been reported that the Permian basin area of West Texas and New Mexico has larger proven petroleum reserves than any area of similar size in the United States.[1] The newer reserves have been discovered and are being developed primarily in fields deeper than the Permian formations from which the area takes its name. Many fields are now producing from six or seven formations of three or four geologic ages. This diversity of producing horizons provides a great variation in drilling problems.

Geology and Drilling Problems

Fig. 1 represents a typical columnar section of the Permian basin formations. The upper Permian zone contains surface sands, the Permian "red beds," a salt section up to 1,500 ft. thick, sandstone, anhydrite, and finally limestone. These upper Permian limestone beds have produced most of the oil in the area for many years. Drilling problems in the section are not usually difficult. The zone does sometimes contain high-pressure, low-volume gas or air pockets that blow out. Lost circulation is frequent, and the salt section presents a mud-control problem, but a 4,500-ft. upper Permian well should be completed in 15 to 25 days under normal circumstances.

In the lower Permian to the Ordovician, drilling problems are more difficult. In all zones lost returns may be expected. Abnormal pressures are occasionally found. The limestones and dolomites are extremely hard, and when associated with chert or flint, drilling rates have, in the past, been as low as 6 in. in 24 hours. Formations are often faulted and folded, and drilling a straight hole is frequently difficult and expensive. The lower Permian, Pennsylvanian, and Mississippian shales, when present, may slough badly and interfere with drilling. This is true at times of the Simpson shales of the Upper Ordovician.

Review of Drilling Costs

In addition to the more difficult drilling problems of the older formations, the most extensive search for and development of lower Permian and pre-Permian fields has taken place since the beginning of the war.

From 1939 through 1945 the average total drilling cost per foot in the Permian basin increased over 100 per cent. This increase in cost resulted from the trend toward deeper drilling as well as from increased labor and material costs. Yet, during 1946, the average cost per foot of hole was less than in 1945.

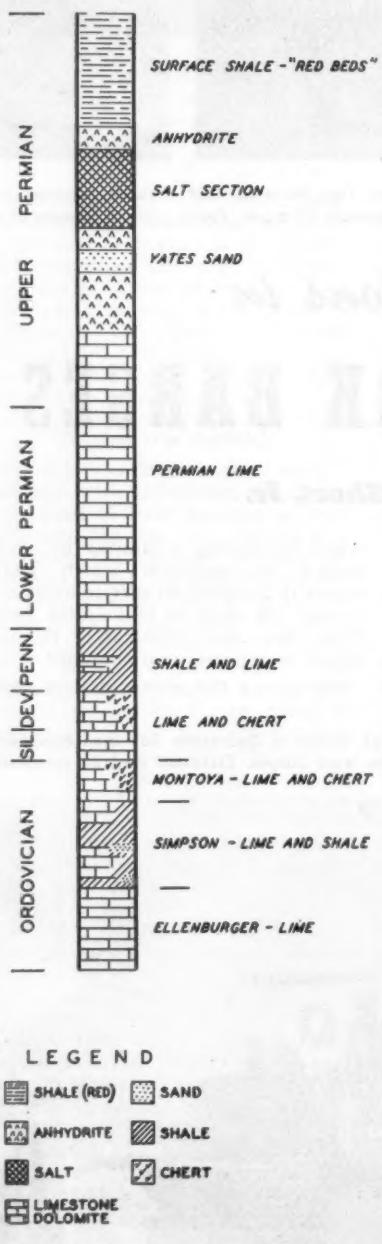


Fig. 1—Schematic section of Permian basin

Since increased cost of labor and materials means more drilling dollars spent per day, a reduction in total well cost must have been made, at least partly, by advances in drilling practices that have reduced total rig time per well. Strangely enough, these advances in drilling practices have tended to increase the per day cost of operating a drilling rig. Many qualified observers have estimated that the average cost of operating a West Texas rig has increased over $100 per day during 1946.

For this reason, and since many items making up total well cost are not affected by rig time, the actual reduction in well cost is considerably less than might be expected from the reduction in drilling time. Total well costs have decreased as much as 15 per cent in most cases. However, it requires a drilling-time reduction of perhaps 40 per cent to offset increased operating costs and still reduce total well cost by 10 to 15 per cent.

A discussion of items making up total well cost coupled with a review of advances in drilling practices should point the way to further de-

TABLE 1

Tangibles—Determined by casing program.
Other well costs—Determined by type of well.
Well roads.
Preparation of location.
Transportation of well equipment.
Cement and cementing services.
Well-logging services.
Other services—perforating, acidizing, etc.
Indirect supervision.

DRILLING COSTS

Rig rental—depreciation and pipe rental.
Rig supplies—all consumable supplies.
Drilling labor—drilling crews.
Fuel and power.
Water.
Direct supervision.
Rig labor—other.
Drilling-rig transportation.
Derrick and foundation costs.
Mud and water pits.
Mud treating.
Tool rental—special tools and equipment.

velopments needed to continue the reduction in drilling costs.

Well costs may be divided into three rather general groups as shown in Table 1 as follows: (1) Tangibles, (2) services and well-location costs, and (3) drilling costs.

Tangibles include casing, tubing, and well-head equipment. The amount of this material required is determined by conditions to be met, either from a drilling-safety standpoint, or from field-rule requirements established for conservation and protection purposes. While additional savings might be made in some cases by design of casing strings to use a minimum amount of steel with adequate safety factors, the total weight of these items, which determines the cost, is generally kept as low as possible by all operators.

In the second group of costs are the items that depend primarily on the type of well and its location rather than on drilling practices and drilling time. Such items as well roads, preparation of the location, cement and cementing services, well logging, perforating, and indirect supervision by the well owner are considered to be part of the well expense separate from the drilling-rig costs, and the expenditure for these items is established by type of location, casing and completion practices, and well-logging practices rather than by drilling time.

In the third group of costs are the items that can be said to make up the cost of actually operating the rig that drills the well. Of these expenses, mud pits, derrick and derrick foundations, and drilling-rig transportation are per-well charges and the total is not materially affected by a change in drilling time. It should be remembered that a reduction in drilling time will increase the cost of these items per rig operating day...

Increased labor and material costs have increased rig operating costs. Faster drilling has increased the amount of materials consumed per day and further increased the daily rig operating costs. Yet, improvements in drilling practices have decreased total rig time per well during 1946 sufficiently to permit an over-all reduction in drilling costs.

Recent Drilling Practices

During 1944 tests conducted in the laboratories of bit manufacturers indicated that drilling rates might be improved in hard formations by increasing bit weight from 1,000 or 2,000 lb. per inch of bit to 5,000 or more lb. per inch. At the same time, it is realized that weight must be applied to the bit by drill collars alone, since running drill pipe in compression reduces drill-pipe life sharply, and high indicated bit weights obtained by compressed drill pipe do not mean that the weight is being applied on bottom. Although these tests had demonstrated the practicability of high weight, it must have been with some fear that a 600-ft. string of drill collars was run into the hole early in 1945 to apply 45,000 lb. to an 8¾-in. rock bit.

TABLE 2—EFFECT OF WEIGHT ON 8¾-IN. BITS

Well No.	Ft. drilled	Hr. rotated	Ft. per hr. rot.	Weight on bit	Bits used
1	4,727	2,205	2.14	10,000	68
2	4,699	1,203	3.90	21,000	72
3	4,682	1,393	3.35	30,000	62

Initial success while drilling with increased weight led most operators to adopt this practice. Fig. 2 illustrates the effect of gradual increases of bit weight on one rig in Andrews County during the past 18 months. Each increase in weight resulted in a decrease in rotating hours to drill the well. Increases in drilling weight increased the footage per bit in most cases. In this series of tests a rotary speed of 100 r.p.m. was employed in drilling the well using 8,000 lb. of bit weight, and a rotary speed of 60 r.p.m. was used in the other three wells.

It is not always good economy to get the maximum footage out of a bit. Table 2 shows some of the early data leading to this conclusion. Three wells drilled in the same area at about the same time were reported to run 10,000, 21,000, and 30,000 lb. on 8¾-in. bits. The rig using 30,000 lb. required the fewest bits. The first reaction to this data was that the 30,000-lb. weight increased bit life and would thus decrease bit cost on the well. But the rig using 21,000 lb. required 190 fewer rotating hours than the rig using the heaviest weight. Adjusting for the time required for the extra round trips to change bits, the net reduction in total time was sufficient to pay for the extra bits and still show a saving in total well cost.

The present practice of most oper-

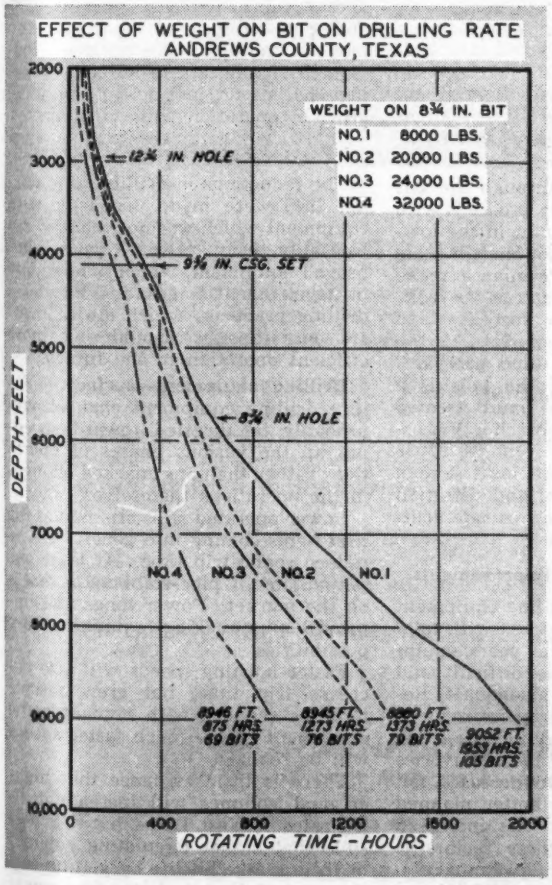


Fig. 2

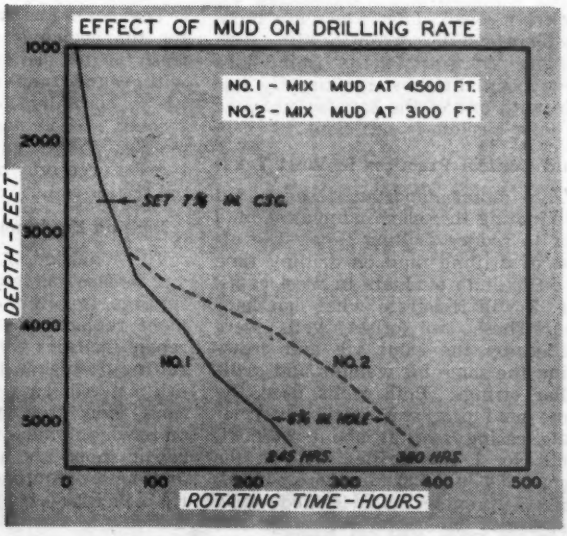


Fig. 3

ators is to change bits before the drilling rate slows down too much, and before the bearings fail. This has been instrumental in drilling some fast wells. A recent well in Winkler County was drilled to 8,065 ft. in 46 days, using 73 bits. Total rotating time was 504 hours or an average of 16 ft. per rotating hour, which is high for West Texas. An average of 1.6 bits were used daily, and while they averaged 110 ft., the average rotating life was under 7 hours. This speed has been made with a large increase in rig-operating costs. An average of two bits a day requires two round trips per day with more daily wear on equipment, and greater fuel consumption in addition to the cost of the bits themselves.

The use of higher drilling weights has brought its problems, and has developed many equipment needs. The most important is the use and care of long drill-collar strings. The need for lower rotary speeds to reduce the failures in the drill-collar string, and to increase the life of bit bearings was realized. Based on experience, it appears that a maximum rotary speed of 60 to 65 r.p.m. is desirable for high-weight drilling. Few operators exceed this maximum, and many use slower rotary speeds.

Another problem is fishing for lost drill-collar strings. At one time, it was general practice to run drill collars small enough to be recovered by washing over. With drill-collar strings as long as 600 ft., washing over is almost impossible because of the difficulty of cutting the thick-walled collars. For this reason it is now rather general practice to run collars of the maximum diameter that can be recovered with an overshot. For example, 5¼-in. overshot slips are normally the largest that can be used in a 6¾-in. hole, so 5¼-in. collars are generally run.

An allied difficulty is fishing for rock bit cones. Lost cones are more frequent while drilling with high weight. At times, these fishing jobs have been difficult, but usually one trip with one of the satisfactory cone or junk baskets is sufficient...

Mud Control Practices in West Texas

The more important reason for eliminating the overtreatment of mud was to reduce drilling time. The effect of drilling mud on drilling time is difficult to evaluate in most cases. Fig. 3 will illustrate what can happen. These two offset wells were drilled by the same rig and crews using the same bit weights and drill-collar strings. Both wells used the same mud programs to the intermediate casing seat at about 2,650 ft. Well No. 1 was drilled with water from 2,650 to 4,500 ft. where a fresh water-bentonite mud treated with caustic and quebracho was mixed and used to total depth. On Well No. 2 it was necessary to mix mud at 3,100 ft. instead of 4,500 ft. in order to get better cuttings for laboratory analysis. The rotating hours-depth curves for the two wells show the results. The mud mixed at 3,100 ft. was the minimum mud required to obtain samples. It had an A.P.I. viscosity of about 33 seconds, weight of under 9 lb. per gallon, and an A.P.I. filtration rate of 40 to 50 cc. Certainly not good mud, but enough to reduce drilling rate.

Mud-treating programs in West Texas must vary with casing programs, cementing practices, and individual field problems. Usually mud treating is divided into two phases: a salt-water mud in the upper portion of the hole, and a fresh-water mud below the intermediate casing.

Mud treatment with the salt section exposed is usually confined to water thinning of the natural red-bed muds. Under some conditions increased viscosity and reduced filtration rates are required. Salt-water dispersable clays and starch are then used as necessary. As previously mentioned, major problems encountered in this section of the hole are lost returns and blowouts from air pockets or from the Yates gas sand. Almost every mud man and drilling operator has a preferred mixture of fibers to use for lost circulation. Success varies, and cementing is often necessary to stop mud losses. Blowouts from air pockets usually die in a few hours. If the Yates gas blows out it is customary to let it blow and keep on drilling. The Yates usually will not produce over 1,500,000 cu. ft. of gas per day but its pressure is abnormally high.

After casing is set through the salt section, drilling usually proceeds with fresh water to some point in the lower Permian. There is not enough shale in this section of the Permian to make any mud, and the best rule for drilling with water is to keep it clean enough to drink.

The basis for most mud programs for the remainder of the hole is a fresh water-bentonite mud treated with caustic and quebracho. Viscosity is normally low, from 34 to 38 seconds A.P.I.; weight low, seldom over 9.5 lb. per gallon; and filtration rate reduced only as low as safe drilling requires...

Drilling-Equipment Improvements

The condition of drilling equipment and its size has much to do with total rig time. During the war years, equipment replacement was difficult and repair facilities were inadequate. Resulting downtime for repairs reduced drilling efficiency and increased rig time. Since the end of 1945, deliveries on new equipment have increased and repair shops are now better manned and better equipped. The increased rig efficiency from these factors is difficult to estimate. On January 1, 1947, there were a total of 2,950 rotary rigs in use in the United States.[2] About 350 of these were actively operating in the Permian basin. The amount of new equipment is indicated by the fact that during the 3 years prior to 1946 an estimated 1,000 rotary rigs of all sizes were sold to domestic and foreign operators. This high percentage of new equipment, coupled with replacement of units on existing rigs to provide increased horsepower and pump capacity is certainly an important factor in reducing drilling time. Replacement of old rigs at the present time will necessarily increase daily rig operating costs because of higher initial costs.

In addition to new equipment, there have been new types of power rigs put in wider use which have been of improved design. Most extensive use of portable masts has reduced rig moving time and costs in many areas.

While still relatively limited, use of semiautomatic equipment such as power slips and semiautomatic feed-offs is on the increase.

Rig designs to reduce moving and rigging-up time have shown some interesting ideas. Some of these are incorporation of water tanks into engine substructures, prefabricated engine-house flooring hinged to substructures, double-decked tool houses with one house on the ground and the second even with the derrick floor, and prefabricated pipe racks of several types. Improved rig design can pay out rapidly in faster, more convenient rigging up; in reduced trucking charges on moves; and in more efficient operation while drilling.

Prospects for Future Changes

The reductions in drilling time during 1946 were made primarily with equipment which was not changed appreciably from prewar types. Improved equipment, which is now only in development stages, and improved drilling practices, which are at present only theories, should give more efficient operation in the future.

Drilling equipment—surface.—Future drilling equipment changes will probably be directed toward speeding up the various phases of operations rather than any marked changes in the operations themselves.

Power-operated slips are among the first items coming into general use to reduce round-trip time. At least one semiautomatic pipe-stabbing device is on the market. Power tongs and improved pipe-racking equipment are possibilities.

Faster hoisting speeds will also decrease trip time, but crew fatigue must be reduced with semiautomatic equipment before much faster speeds will be realized.

There is little evidence that higher mud volumes will increase drilling rates in West Texas, but it is possible that higher circulating volumes might increase bit life by getting cuttings out of the hole faster. The power

(Continued on page 100)

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Application of Automatic Control to Gasoline Plant and Refinery Processes

by E. H. Reynolds,* William Troutman,* and Gordon Lawn*

SUCCESSFUL application of automatic controls involves the solution of three types of problems, viz: (1) Rapid and accurate measurement of the variables of the process to be controlled. Successful control is impossible without dependable measurement. (2) Rapid and precise application of corrective measures so as to maintain the controlled variable at the desired point with minimum deviation. (3) Selection of suitable variables of the process.

There are two general systems of control in industrial service: electrical and pneumatic. The pneumatic control is more modern and presents several advantages over the electrical. Its initial cost is less, it is more flexible, servicing is less complicated, and it presents no fire hazard. For this latter reason, probably more than any other, it appeals particularly to the petroleum industry, and is in such common use in this field that the terms "control," "controller," etc., appearing in this paper will be considered to apply to the pneumatic system only.

*Richfield Oil Corp. A paper presented at the February 6 meeting of the California Natural Gasoline Association, Los Angeles.

In choosing an instrument for a control job, it is necessary to consider its characteristics first as a measuring device, and second as a controller. The subject of measuring devices is too broad to be covered adequately in this paper. No attempt will be made to do more than note the more common types along with some of their outstanding characteristics and limitations.

Measuring devices can be noted as follows:

Temperature. — Pyrometers: This class includes millivoltmeters and potentiometers. Both have as a primary element a thermocouple made of two dissimilar metals welded together at one end. The most common metal combinations in use as thermocouples in the refinery are iron-constantan with a normal range of 0°-1,500° F. and chromel-alumel whose normal range is 0°-1,800° F.

A high degree of accuracy is obtainable with potentiometers. It is possible to have them check within ±0.1 per cent of total range. They make very satisfactory controllers. This is especially true of the continu-

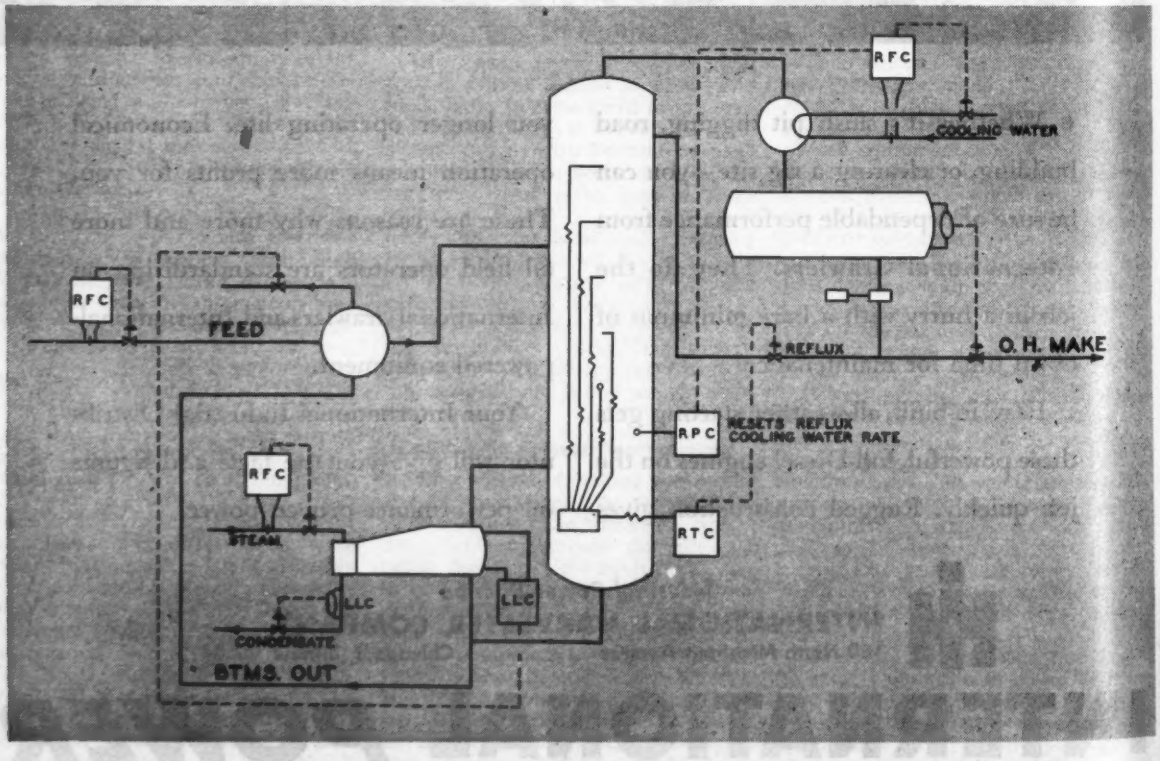

Fig. 1—Automatic control applied to the operation of the deisobutanizer column

ous-balance type, since temperature changes are recorded without delay.

Thermometers: Bulb-capillary-type thermometers are widely used as they are generally less expensive than pyrometers. They are commonly classified as follows:

Class 1—Liquid filled, other than mercury. Work on principle of volumetric expansion. Evenly graduated chart. Temperature limit 400° F.

Class 2—Vapor tension. A change in temperature causes a change in the vapor pressure of liquid filling medium. Unevenly graduated chart. Temperature limit 600° F.

Class 3—Gas filled. Volumetric expansion of gas. Evenly divided chart. Temperature limit 800° F.

Class 4—Mercury filled. Volumetric expansion of mercury. Evenly divided chart. Temperature limit 1,200° F.

Ambient temperature changes along the capillaries of these systems cause errors, excepting in Class 2, where they are minimized. Compensators are necessary to overcome this effect, especially where long capillaries are used. This type thermometer should not be used as controllers when capillaries are over 200 ft. in length since lag is too great.

Pressure.—Pressure-measuring devices are distinguished by the type of primary element employed—bourdon tube, spiral, helix, and metallic bellows. Usually the bourdon tube is used for high pressures, the spiral or helix for intermediate pressures, and the metallic bellows for low pressures. Location of pressure taps should be given some thought, remembering that the primary element will measure any static head present in addition to vessel pressure.

Flow.—The differential-type flow meter with an orifice plate for a primary element is the standard means of flow measurement in the petroleum industry. There are two general classes in use, the mercury manometer, and the sylphonic-bellows. The former is the older and by far the more common type.

The differential flow meter is readily adaptable to control purposes.

Liquid levels.—Liquid levels fall into two general classes, float type and differential type. The first includes the recently developed displacement-type liquid level. The differential type is an adaptation of the familiar differential flow meter.

It is common practice to let the level of the liquid swing between certain limits rather than holding it to a fixed point. This permits the addition or withdrawal of liquid from the vessel at a more gradually changing rate and may cause less upset in the process.

In the study of a control problem, consideration must be given to the type of control element best fitted for the particular job. There are available:

1. The on-off controller in which the control valve is either wide open or closed, depending on the position of the variable with respect to the control point. It has some application in batch processes.

2. The narrow-band proportional controller in which the control valve moves with the pen as it deviates from the control point, but at such a rate that a pen movement of from 1 to 10 per cent of the chart range, depending on the throttling range setting, will move the valve from a closed to a wide-open position or vice versa. This control is useful in processing having very small time lag. It is designed to check the process deviation, but will not bring it back to the control point.

3. The wide proportional band controller is the same as the narrow-band controller, except that it allows a choice of throttling ranges of from 1 to 150 per cent.

4. The proportional controller with automatic reset in which the addition of automatic reset to the wide-band proportional controller makes it an element that will not come to balance until it has changed the air to the control valve sufficiently to bring the variable back to the control point. It is adjustable so as to set the rate at which the process variable will be returned to normal setting.

In many operations, control is improved by the inclusion of a valve positioner. This is true whenever conditions arise whereby the control valve does not readily respond to small changes in air pressure. They function by continuing to increase or decrease air pressure on the valve diaphragm until the valve assumes the position required by the primary control.

Consideration must be given to the ability of the measuring element of any controller quickly to detect a variation in the controlled medium and to actuate a mechanical device to correct this variation without undue loss of time; otherwise lag is introduced into the process. Lag is a term used to indicate the time interval between a process change and the repositioning of the final control element as a result. This can be broken

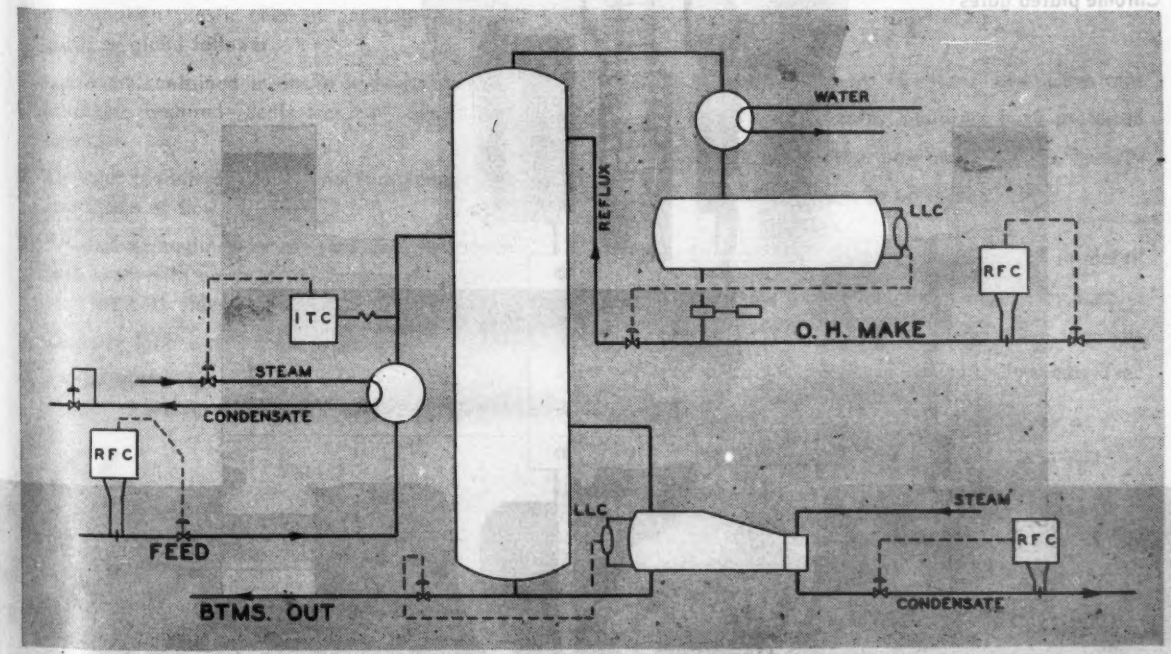

Fig. 2—Application of automatic control to a deisopentanizer tower

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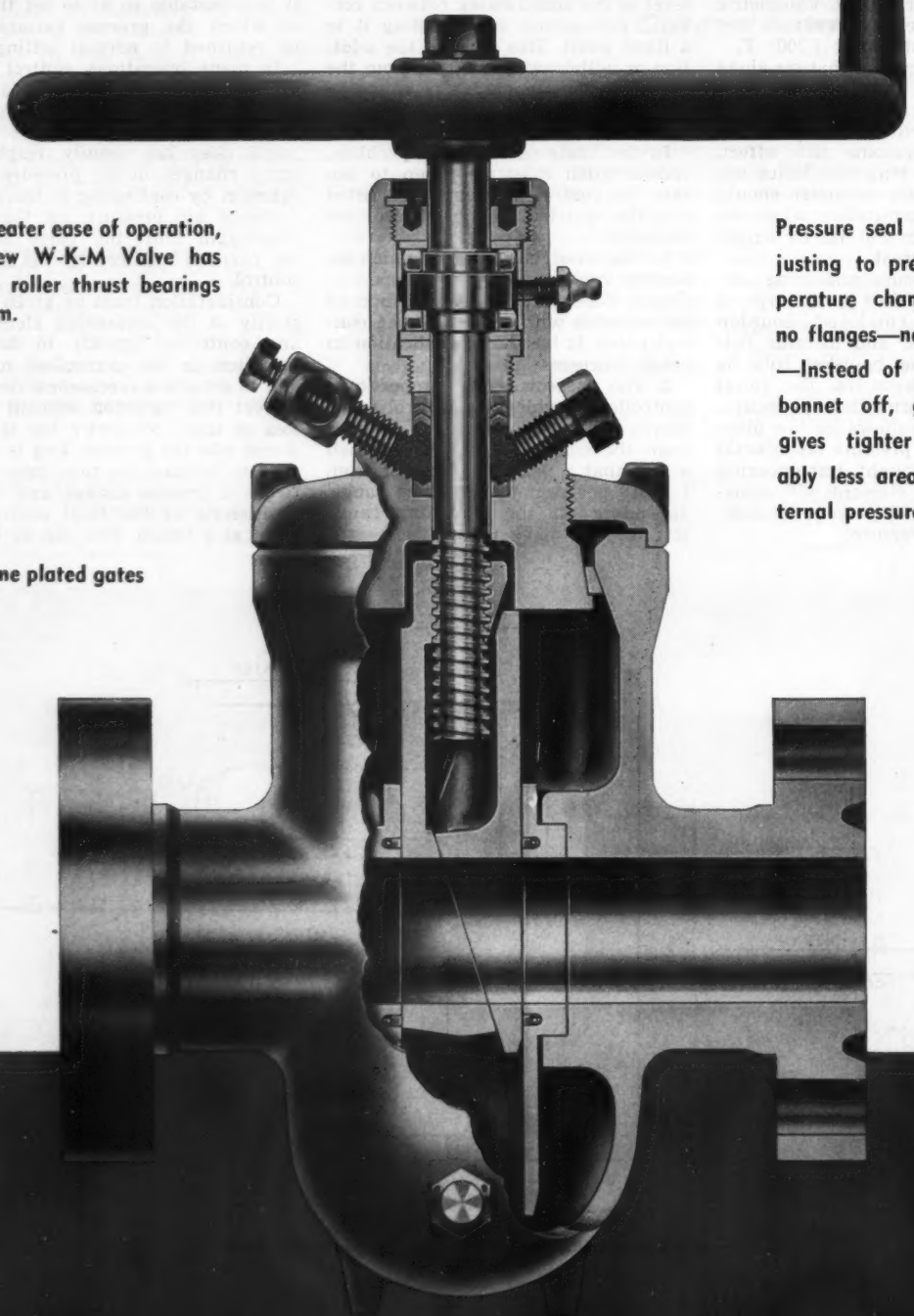

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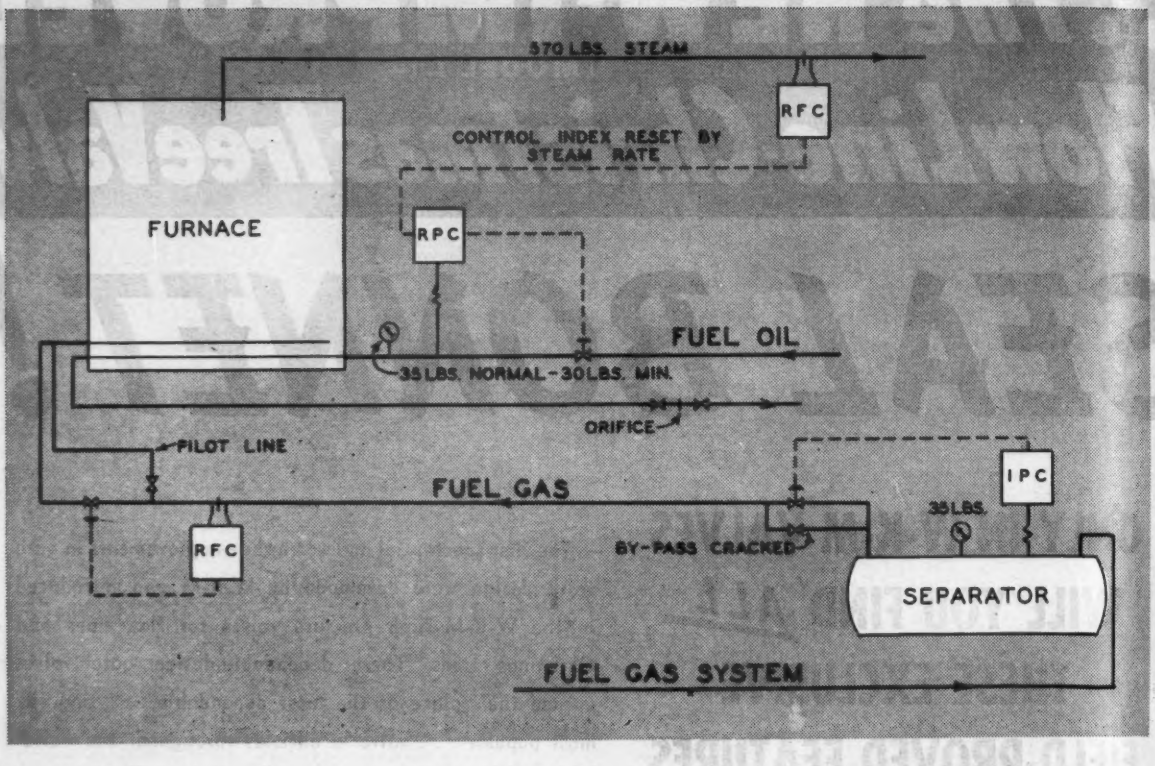

Fig. 3—Application of automatic control to problem of maintaining the pressure in the refinery fuel-gas system by burning the excess gas under the steam boilers

down into (1) process lag, and (2) measurement-control lag. Lag is the principal bugbear of good control and its effect must be minimized whenever possible.

In order fully to appreciate the number of sources of lag in a control system, let us consider a bulb-type temperature controller. A change of temperature outside the thermometer bulb is transmitted through the bulb wall and into the filling medium. This increases the pressure in the bulb; this pressure travels through the capillary to the spiral, moving the spiral. The spiral works through the control mechanism sending out a new air pressure through the connecting tubing to the control valve. The control valve changes the quantity of controlling medium. These steps follow in sequence, and although they overlap to some extent, there is, of necessity, an unavoidable time lag. This inherent lag is not the same for all types of measuring devices, nor is it the same for various makes of pneumatic systems. Consideration should be given to this when planning the control of a critical process.

At any of the numerous steps between the variable change and the final control element, sufficient lag may develop greatly to impair the usefulness of a controller. Cause of lag in a temperature controller might be:

The bulb or thermocouple is poorly located in the equipment.

The well is too heavy, or of poor thermal transmission qualities, or dirty.

There is an air space between the bulb and well.

The bulb is not fully immersed.

The capillary is too long.

There is loss of sensitivity in the measuring element.

There is lost motion or friction in controller elements.

The pneumatic pilot has low capacity.

There are air leaks in pneumatic system.

Control-valve action is sluggish.

Recently a study was made of the lag characteristics of copper tubing to determine the relative effect of tubing sizes and lengths. The test covered ¼, ⅜, and ⅝-in. tubing in lengths of 50 to 300 ft. by 50-ft. increments. To simulate operating conditions, a control valve with pressure gage was attached to one end of the tubing. The controllers were set to deliver 15½ lb. air and a cock was introduced between the controller and tubing. The time interval between opening the cock and the showing of 15 lb. at the control valve was clocked. Four standard controllers were used. One of the controllers developed less lag in the ⅜-in. tubing than in the ¼-in., being 10 per cent faster for 50 ft. and 5 per cent faster for 300 ft.; it was slower when tested with ⅝-in. tubing. The other three controllers made their fastest delivery through ¼-in. tubing for all lengths tested. No two controllers delivered air at the same rate, and they held their relative positions throughout the tests, the one being fastest for any length of any diameter tubing was fastest for all lengths and all diameters. The relative delivery rate of the fastest and slowest controllers was about 6 : 1.

With the control instruments that we have to work with in mind, let us now turn to the problem of selecting the variables to be controlled, and go to Fig. 1. This process is the operation of a deisobutanizer column. Feed to this column has approximately the following composition:

Propane	1 to 2 per cent
Isobutane	6 to 10 per cent
n-Butane and heavier	88 to 93 per cent

The operation desired is production of an overhead containing a minimum of n-butane, while very low loss, say of not over 0.1 per cent of isobutane is permitted in the bottoms.

The factors affecting the process that must be controlled or compensated for, are: feed composition and rate, cooling water temperature and pressure, steam temperature and pressure, and tower heat loss.

The flow controller on the feed controls the feed rate directly, since variation would throw an additional load on all ensuing controls.

The flow controller on the steam to the reboiler is used to minimize

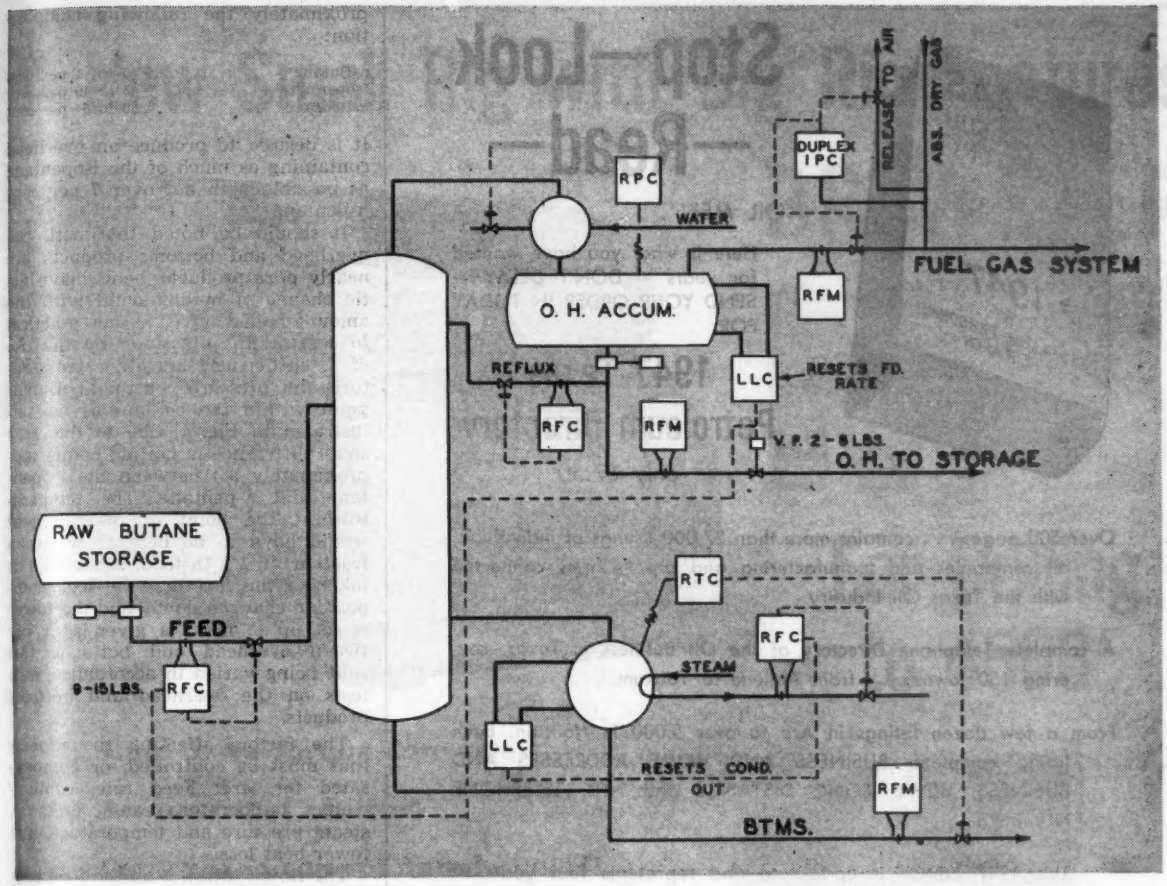

Fig. 4—Automatic means of limiting variations of fuel-gas pressure by use of a duplex pressure controller which will allow makeup gas to go to the system when the pressure drops to a set point, or will vent gas to the air if the pressure rises to a predetermined point

fluctuations of heat input due to variations of steam pressure. A pressure controller on the reboiler steam pressure might be preferable to the flow controller used, but the flow controller was on hand and was used since variations in heat input are compensated for by other controls.

The liquid level control on the reboiler condensate is used to release condensate from the reboiler at whatever rate formed.

The temperature control is used to control the temperature on one of several points in the tower, since at constant pressure this will maintain the products close to that desired despite normal variations in feed composition, heat input, and tower heat loss. Location of the point at which the temperature in the tower is controlled must take into consideration the particular type of operation desired. If the temperature at the bottom of the tower were controlled, variations in the heavy material in the feed stock would affect this temperature without necessarily reflecting a change in the overhead product. If the top temperature of the tower were controlled, the varying propane content would have an appreciable effect on this temperature, and so the n-butane content would vary inversely. By selecting an intermediate point, it is possible to minimize the effect of variations of propane in the overhead and still have a point which will vary with changing n-butane content of the overhead. The actual point used is the fifty-third tray from the bottom in a 70-tray tower. This temperature is controlled through varying the reflux to the tower since reflux enters at a point near enough to that of temperature measurement that a reasonable time lag in the process will result.

Operation of Pressure Control

The pressure-control tap should be as close as possible to the point at which the temperature is controlled, since a given temperature controls the product produced only at a given pressure. The pressure control operates by controlling the cooling water through the overhead condenser, thus varying the condensing rate on the overhead. In order to compensate for variations in cooling-water pressure without first requiring a change of pressure in the tower, a flow controller is used in the overhead-condenser water system. The tower pressure controller resets the control index of this flow controller. This is necessary in the particular application because of other equipment taking off of the same cooling-water system, and in cutting between isobutane and n-butane with a difference in boiling point of 19°, very close temperature and pressure control are required to maintain product composition.

The liquid level control on the overhead controls the overhead make and thus adjusts for the varying ratio between overhead and bottoms due to feed stock composition change. The liquid-level control on the reboiler serves the same purpose, but it might be noted that this is a differential-type controller having proportional control with automatic reset, and is used because it is desired to maintain the bottoms flow at as constant a rate as possible and still keep the level within limits. This is necessary on account of the bottoms heat exchange with the feed stock so that the temperature of the feed to the tower will remain as constant as possible.

Fig. 2 represents application of automatic control to a deisopentanizer tower. Feed to this column is of ap-

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proximately the following composition:

n-Butane	0 to 1 per cent
Isopentane	45 to 49 per cent
n-Pentane	50 to 54 per cent

It is desired to produce an overhead containing as much of the isopentane as possible with not over 7 per cent n-pentane.

It should be noted that both the overhead and bottoms products are nearly pure products, hence have little change of boiling point with the amount boiled off. It is not practical to control this operation by the use of a sufficiently sensitive temperature and pressure control at a midpoint within the column as was illustrated in Fig. 1, due to the very small difference in boiling points (approximately 9°) between the isopentane and n-pentane. The temperature at the point of measurement would have to be held to within a fraction of 1°. Instead, advantage is taken of the fact that the feed composition changes slowly and the tower is set up to make a given split between overhead and bottoms, this split being varied in accordance with tests on the overhead and bottoms products.

The factors affecting the process that must be controlled, or compensated for, are: Feed rate, cooling-water temperature and pressure, steam pressure and temperature, and tower heat loss.

The flow controller on the feed controls the feed rate directly. The temperature controller after the feed preheater controls the heat input with the feed and compensates for variations in steam pressure to the preheater. The flow controller on the condensate from the reboiler controls the heat input through the reboiler and compensates for changes in steam pressure to the reboiler. The flow controller on the overhead product sets the split between overhead and bottoms. The liquid-level control on the overhead accumulator compensates for any changes in heat input or cooling by varying the reflux rate to hold this level. The liquid level control on the bottoms controls the bottoms make as available, while maintaining a liquid level in the reboiler.

Fig. 3 represents application of automatic controls to the problem of maintaining the pressure in the refinery fuel-gas system by burning the excess gas under the steam boilers. In the refinery there are many processes consuming fuel gas and many processes releasing gas into the fuel system. Due to variations in operation, the balance on fuel gas in the refinery is always changing. Before the present controls were set up, commercial gas was available to take this swing. When this was no longer available, it became necessary either to waste large quantities of gas during

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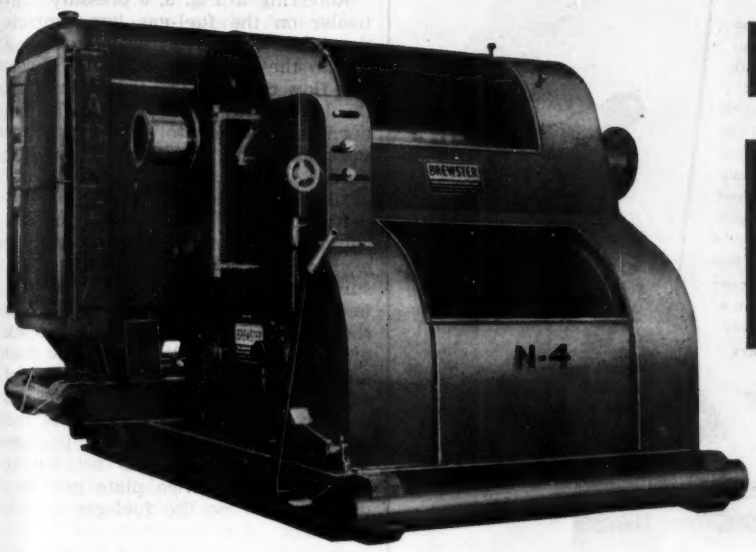

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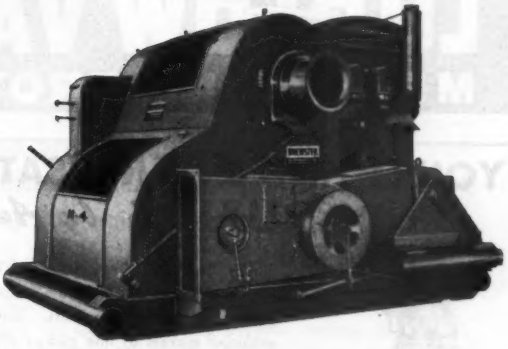

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periods of excess, or to arrange satisfactorily to use this gas in varying quantities as available. Many fluctuations in this gas supply are too fast to permit manual adjustments of fuel gas consumption in the refinery.

Referring to Fig. 3, a pressure controller on the fuel-gas line controls the pressure on this line by releasing gas to the burners under the boiler. The flow controller on the steam from the boiler controls the fuel oil to the burners in order to compensate for variations in the amount of gas burned, as they tend to cause a change in the steam flow. In order to compensate for variations in the fuel-oil supply pressure without first causing a change in the steam flow, a pressure controller is used on the fuel oil to the burners. The flow controller on the steam resets the control index of the pressure controller on the fuel oil. The flow controller on the fuel gas to the boilers serves to limit the amount of gas which can go to the boilers since it will not permit passage of more gas than it is set for at the maximum orifice plate pressure, which would be the fuel-gas system pressure.

The above control system will accommodate changes of rate in the available fuel gas of approximately 150,000 cu. ft. per hour, making this change if necessary in 2 to 3 minutes without noticeably affecting the output of the boilers.

The above fuel-system pressure-control arrangement is sufficient to accommodate most normal changes but is not sufficient to take care of surges sometimes caused by upset operation, particularly of a cracking plant. These plants can change very suddenly from a net producer of fuel gas to a very large consumer of gas when operation is badly upset by say a power failure. At a time such as this, if the large quantity of fuel gas required were not immediately available, temperatures would continue to fall and operation would be lost. There are also times due say to a sudden increase in fuel gas from the vapor-recovery system, when the excess fuel gas is temporarily more than can be burned.

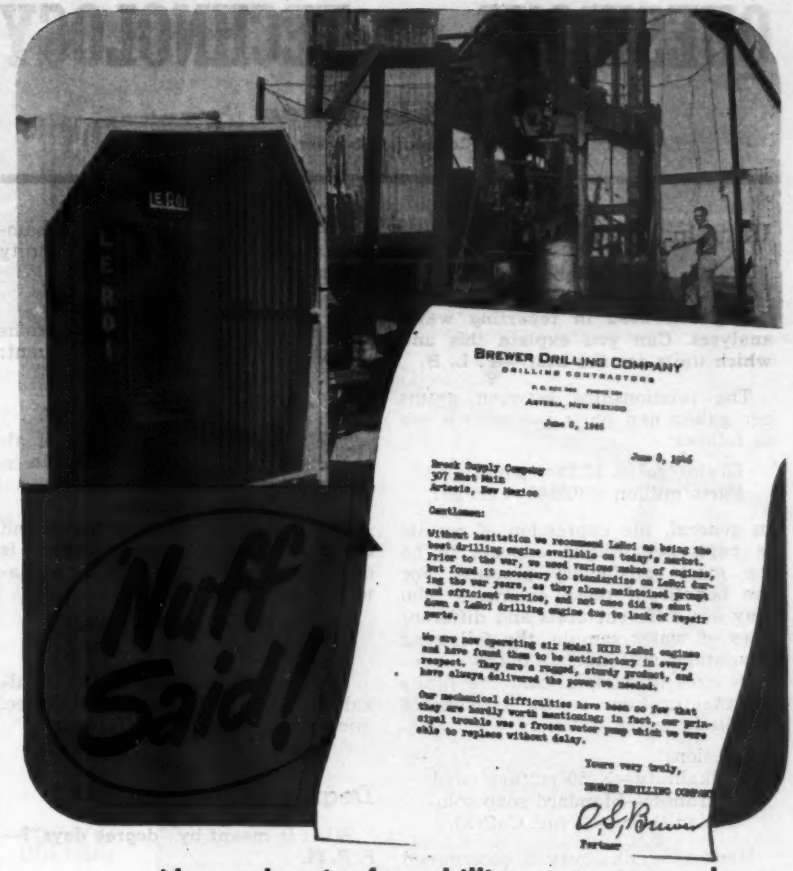
Fig. 4 shows an automatic means of limiting variations of fuel-gas pressure by use of a duplex pressure controller which will allow makeup gas to go to the system when the pressure drops to a set point, or will vent gas to the air if the pressure rises to a predetermined point. In order automatically to have gas available for makeup into the fuel system, a stabilizer is kept in operation feeding n-butane stock, the overhead from which returns to the feed tanks while the bottoms product containing any material heavier than n-butane is discarded to other tankage. The operation desired on this stabilizer is the supplying of fuel gas containing noth-

ing heavier than n-butane, at any time, and in whatever quantities are required.

Referring to Fig. 4, when no makeup gas is required the feed to the stabilizer is controlled at a preset minimum which will allow the feed pump to operate properly. As a level is built up in the reboiler, the reboiler liquid-level control increases the flow of condensate from the reboiler by setting the control index on the condensate flow control until all material in excess of that required to maintain the reboiler level is boiled off back into the tower. The temperature control operates from the reboiler temperature and adjusts the bottoms rate to permit removal of all material heavier than n-butane. In order that the temperature of the material in the reboiler will indicate its composition, a constant pressure is maintained. The pressure controller which does this adjusts the water rate through the overhead condenser. Material not going out as bottoms will go overhead and appear in the overhead accumulator. The liquid-level control on the overhead accumulator adjusts the overhead make to maintain a level in the upper part of this vessel. The flow controller on the reflux to the tower maintains a set reflux rate sufficient to insure removal of the heavy material in the bottom product.

When makeup gas is withdrawn for the fuel system, the pressure controller decreases the amount of overhead condensation to maintain the set pressure. This results in the liquid level in the overhead accumulator starting to drop, causing the level control to decrease the amount of overhead returned to storage. The control valve on the overhead product is coupled with a valve positioner set to give full valve travel for a 2-8-lb. range of the controlling air pressure. When the liquid level on the overhead accumulator has reached midpoint, the overhead valve is closed. If the gas release is greater than the minimum set feed will provide, the liquid level in the overhead accumulator will continue to fall and thereby increase the feed to the tower by raising the control index on the feed flow controller. The control index of the feed controller was adjusted in our own shop so that it travels full scale for a 9-15-lb. range of the controlling air pressure. However, there are now commercially available index-setting mechanisms which are adjustable both as to the air pressure at which motion starts and also as to the rate of movement with change of air pressure.

When the gas requirement for makeup to the fuel system decreases, the above process reverses itself and will return to the original operation or will stabilize itself at any intermediate point.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QUESTIONS on TECHNOLOGY

by ***W. L. Nelson***
Consulting Engineer

Units in Water Testing

We are confused about relation between parts per million and grains per gallon used in reporting water analyses. Can you explain this and which units are the best?—F. L. B.

The relationships between grains per gallon and parts per million are as follows:

Grains/gal. × 17.15 = p.p.m.
Parts/million × 0.0583 = gr./gal.

In general, the expression of results in parts per million appears to be the most satisfactory practice. For the benefit of those engineers who may use different units and different sizes of water sample, the following tabulations will indicate the two common sizes of samples and the limits for the titrations on the effluent of lime-soda water softeners.

Solutions:
Alkalinity—N/50 sulfuric acid.
Hardness—Standard soap solution (1 cc. = 1 mg. $CaCO_3$).

Hydroxide alkalinity is determined by titrating the samples of treator effluent with the standard acid using phenolphthalein as an indicator and the milliliters of acid required is recorded as the P value. Methyl orange indicator is then added and the titration is continued to the MO end point or value. Perfect treatment is attained when the value of (2P — MO) is small (see tabulation for exact limits).

A slight excess of sodium carbonate is advisable in the water treatment. This may be checked by determining the total hardness by means of the soap test. This test involves determining the amount of soap solution required to produce suds that will last for 5 minutes. A small value (see tables for exact value) of 2(MO — P) — H indicates a suitable excess carbonate alkalinity.

The two common sizes of samples are 50 and 58.3 cc. These sizes of samples are used for both the alkalinity and hardness tests.

50-cc. Sample

When using the above solutions and using a 50-cc. sample of effluent:

Cu. Cm. × 20 = p.p.m.
Cu. Cm. × 1.166 = gr./gal.

The upper and lower limits of alkalinity of the effluent are shown in Table 1.

58.3-cc. Sample

When using the above solutions and using the 58.3-cc. sample which is often referred to as the U. S. miniature gallon:

Cu. Cm. × 17.15 = p.p.m.
Cu. Cm. × 1.0 = gr./gal.

The upper and lower limits of alkalinity of the effluent for a 58.3-cc. sample are as shown in Table 2.

Degree Days

What is meant by "degree days"?—F. R. M.

In judging the heating load of domestic and industrial heating furnaces, it is necessary to take into account variations in the weather, particularly with relation to the temperature maintained within the establishment. The common method of evaluating this situation is by means of degree days. The degree day is computed by subtracting the average (daily) weather or outside temperature (°F.) from a suitable inside or building temperature.

It is nearly standard practice to take 65° F. as the basic house or home temperature. This is based on the fact that 70° F. is a comfortable house temperature, and that an outside average temperature of 65° F. will range from above 70° F. during the daytime to below 60° F. at night. Industrial basic temperatures of 45° and 55° F. are sometimes used for such establishments as plants, mills, and some commercial buildings.

If the average weather temperature is 45° F., the degree day will be (65 — 45) or 20 for a home (or might be 0 and 10 for industrial buildings held at 45° and 55° F. respectively). In northern cities, such as Chicago, Detroit, and Milwaukee, the degree days for the month of September are about 75 whereas during January they are about 1,300.

TABLE 1

	Hydroxide alkalinity		Carbonate alkalinity	
	Lower limit	Upper limit	Lower limit	Upper limit
Value of (2P — MO) in cc. of N/50 sulfuric acid	0.5	1.0	....	....
Value of 2(MO — P) — H	....	....	1.0	1.5
Parts per million, expressed as $CaCO_3$	10.0	20.0	20.0	30.0
Grains per U. S. gallon, expressed as $CaCO_3$	0.583	1.166	1.166	1.749

TABLE 2

	Hydroxide alkalinity		Carbonate alkalinity	
	Lower limit	Upper limit	Lower limit	Upper limit
Value of (2P — MO)	0.583	1.166	....	....
Value of 2(MO — P) — H	....	....	1.166	1.749
Parts per million, expressed as $CaCO_3$	10.0	20.0	20.0	30.0
Grains per U. S. gallon, expressed as $CaCO_3$	0.583	1.166	1.166	1.749

Cost of Coal and Oil

With Bunker C oil at $2.18 per barrel and 14,000-B.t.u. coal at $10.50 per ton, which is the cheaper to use?—M. R. C.

The plain matter of fuel cost can be answered directly but the cost of other facilities and auxiliaries depends on the particular situation. The heating-value equivalents of a large number of fuels were discussed and compared by means of a chart in The Refiner's Notebook No. 114, October 12, 1946, page 111, of The Oil and Gas Journal.

The relative cost of a million B.t.u. of gross heating value is somewhat as follows:

	H.V. B.t.u. per lb.	Equivalent	Cost/ MM-B.t.u.
Oil, A.S.T.M. No. 6	18,000	1 bbl.	$2.18
Coal	14,000	.225 ton	$2.36

However, in firing coal or oil other factors should be considered. With respect to coal:

1. Cost of handling; i.e., storage, unloading, etc.
2. Cost of firing; i.e., coal passers and/or power for stoker.
3. Cost of removing ashes.

Similar considerations for oil firing involve:

1. Cost of storage, i.e., tanks, lines, etc.
2. Steam and pumps needed to heat and pump oil.
3. Power or steam required for atomization.

This department is unable to advise regarding the cost of handling, storing, and firing coal. With respect to oil, the cost of small storage tanks (200-500 bbl.) ranges from $1.50 to $3.00 per bbl.; the amount of steam required for pumping (2 parts circulated for 1 burned) is about 4 lb. per bbl.; the steam for heating ranges from 15 to 25 lb. per bbl.; and the steam required for atomization ranges from 60 to 150 lb. steam per barrel of oil for inside mix burners. Thus, the total consumption is 80-180 lb. per bbl.

Finally, the draft required in burning oil is a little less (0.2 in. water) than when firing coal and the amount of excess air required in firing oil is slightly less than when firing coal.

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Motor-Fuel Trends in Relation To Antiknock Requirements

by T. H. Risk and Jane F. Jordan

FIG. 1 shows the trends in the motor and research-method octane ratings of regular and premium-grade gasolines since the initial lifting of all restrictions on civilian fuel just after V-J Day. These curves show the dip in antiknock levels which fuels took during the latter part of 1946 as a result of the reinstating of government restrictions on tetraethyl lead and maximum octane numbers.

Although average motor method data on gasolines are readily available for the years before the war, corresponding research method data are very limited so that it is possible only to estimate the average prewar sensitivity of fuels. Sensitivity is defined as the research-method rating minus the motor-method rating. Such data as are available indicate that, on the average, prewar motor fuels were about of the quality shown in Table 1. Similar data for the present from Fig. 1 are included for comparison. These figures indicate that the petroleum industry is now able to make fuels which are not only higher in motor-method octane number but also of greater sensitivity than their prewar predecessors.

The most recent antiknock data for January and February 1947, since all government restrictions have once more been lifted, demonstrate that the initial upward trend just after V-J Day has been resumed. Octane numbers and sensitivities are approaching the levels they attained in the fall of 1945. In predicting where these values may go between now and 1950, the maximum octane-number data are an excellent guide. Regular-grade fuels of 80 motor method and 88 research look entirely feasible while premium-grade fuels of 85 motor, 95 research rating appear to be equally likely. The existence of a fair proportion of samples over the last year at these levels is rather convincing evidence of the reasonableness of such predictions.

Naturally, refiners who are in a position to make such fuels economically are likely to do so. Other re-

TABLE 1

	Prewar 1941	Postwar 1946
Premium grade:		
Motor method	80	82
Sensitivity	6	7
Regular grade:		
Motor method	75	77
Sensitivity	5	6

THE AUTHORS

T. H. RISK

JANE JORDAN

Thomas H. Risk is manager of the refinery division of Ethyl Corp.'s engineering research laboratories. He has guided many studies to evaluate the antiknock characteristics and tetraethyl lead susceptibilities of motor-fuel components in vehicles on the road. Particular emphasis has been placed on the relation of the hydrocarbon distribution throughout the boiling range of the fuel to these properties. He is author or coauthor of a number of papers relating to the mutual adaptation of motor fuels and engines and is credited with several patents on motor fuels.

Prior to joining Ethyl Corp. in 1940, Risk was with Pure Oil Co. at its laboratories in Winnetka, Ill., and also with the research and development division of Socony-Vacuum Oil Co., Inc., at Paulsboro, N. J. He is a graduate of Cornell University and is a member of A.P.I. and S.A.E.

Jane F. Jordan has been a member of the refinery division of Ethyl Corp.'s engineering research laboratories since the division was organized in 1940. She is concerned primarily with the refinery division problems in which chemistry is involved. She is author or coauthor of several papers which have been presented at technical society meetings and has assisted in the preparation of a number of papers given by other members of the department.

Miss Jordan is a graduate of University of Chicago and is a member of the petroleum division of the American Chemical Society. She was formerly with the research and development laboratories of Universal Oil Products Co. at Chicago.

This article is a slightly abridged version of a paper presented at last week's meeting of the Western Petroleum Refiners' Association, at San Antonio.

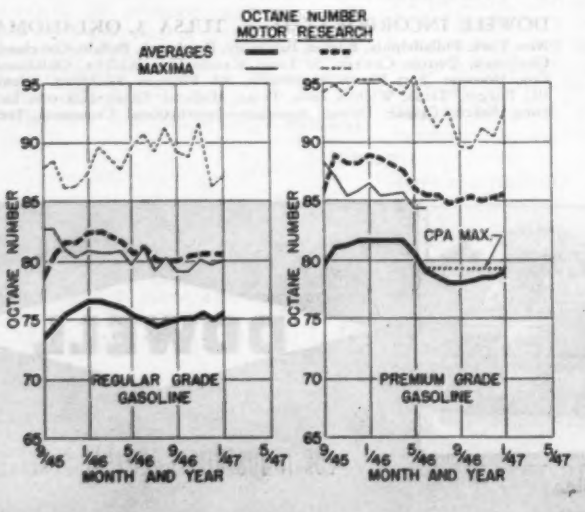
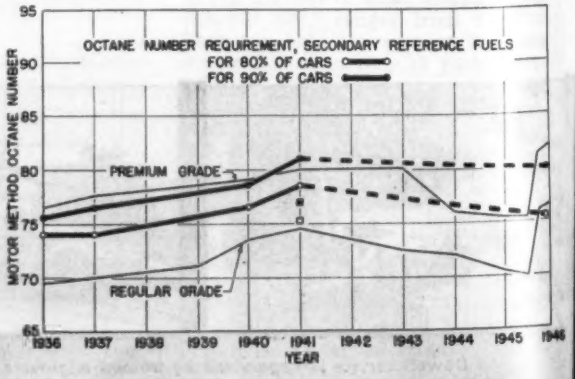


Fig. 1—(Left) Trends in gasoline antiknock levels since V-J Day

Fig. 2—(Below) Trends in octane requirement and fuel antiknock quality



finers may, as a result, find themselves at a competitive disadvantage. This latter group, perhaps, may take comfort from the fact that the present passenger-car population probably doesn't require such fuels and that they can get by without serious complaints from their customers until such time as the automotive industry puts new engines of higher requirement on the market. Actually, it is an interesting fact that, as Hebl and Rendel stated back in 1939, "The so-called octane requirements (of cars) are not a direct function of the design of the cars or their operating conditions, but depend largely on the octane number of the fuel available to them in any given territory."*

This fact is illustrated in Fig. 2. Surveys of the octane requirements of the passenger-car population current at any time have not been conducted on anything like the controlled, regularized basis of surveys of the laboratory octane numbers of available fuels. Consequently, the data presented in these curves are scattered and by no means infallible. However, they do illustrate the point made by Hebl and Rendel.

At first glance, it would appear that the premium fuels available up to 1940 were barely good enough to satisfy 90 per cent of the cars on the road. It must be remembered, however, that the octane-requirement curves are actual road requirements. The available fuels, for which only motor-method octane numbers are shown, had road octane values several octane numbers higher, depending upon their sensitivity. It is a reasonable assumption that the regular-grade gasolines made available by the petroleum industry usually satisfy at least 80 per cent of the cars so that it is likely that the road value of the regular-grade gasolines available between 1936 and 1940 approximated rather closely the octane requirement curve for 80 per cent of the cars. The same type of reasoning indicates that, in general, premium-grade gasolines have had road antiknock values which were higher than required by 90 per cent of cars.

It will be noted, however, that as octane numbers have climbed, the requirements of the cars also have increased. The 1941 data are particularly interesting in this connection. The curves show that the octane requirements of the cars at this time were approaching premium-gasoline quality to a greater extent than ever before. It should be remembered that the engine manufacturers deliberately retard their distributor curves from maximum-power spark advance, especially at low speeds. Thus, when fuel antiknock quality allows it, the motorist can derive benefit from advancing the spark toward maximum power setting. This point is illustrated by the open and solid squares below the octane requirement lines for the 1941 data. These are the corresponding octane requirements of the same group of cars tested after the basic spark settings had been adjusted to the manufacturer's recommendation. It can be seen from these points that the availability of better gasolines encourages motorists to advance spark timing to take advantage of the fuels. Another factor which influences this tendency toward increased requirement is that with better fuel in the tank, the motorist drives his car longer before deposit accumulation reaches a level where knocking is bothersome or actual trouble forces him to give his car mechanical attention.

The only octane-requirement data at hand for recent car populations are those shown for the latter part of 1945. These are connected to the 1941 data by the heavy dotted lines. If it is assumed that these dotted lines are reasonable estimates of the requirements of civilian cars during the war period, it is easy to see why the drastic reductions in the quality of civilian fuels necessitated by the emergency brought such an increase in knocking complaints. Even premium-grade fuels were barely able to satisfy 80 per cent of the cars. The 10 to 15 per cent of the cars which required fuel of better quality than the average premium were subject to considerable difficulty. As a result, spark timing was retarded and in certain cases compression ratios even were decreased to accommodate the cars to the fuels available, with attendant losses in performance and economy, of course. This situation also helps to explain the decided swing toward premium-grade fuels which took place during the war years. This habit, once formed by the motoring public, has persisted so that premium-gasoline sales remain at about 40 per cent of the total.

The late 1945 data indicate that fuels are once again in advance of the engine requirements. It will be noted that, for the first time, regular-grade gasolines probably have sufficient antiknock quality on the road to satisfy at least 90 per cent of the cars. This is to be expected from the trends toward greater sensitivity illustrated in Fig. 1. Premium-grade gasolines are obviously much better than required by any but a few models. However, before refiners who are struggling to meet octane competition take any particular comfort from this momentary advantage, they should remember the facts illustrated by the data from 1936 to 1941. When these better fuels are made available in large quantities in an area, the cars there gradually begin to require them. It is safe to predict that when the higher-octane fuels have been available for 6 months to a year, that is by the end of 1947, a survey of the octane requirements of cars at that time will show an upward swing. This, of course, is provided there are no further curtailments of the industry's progress.

Trends in Automotive-Engine Design

The fuel requirements of the car population from 1947 on naturally will be affected by the influx of new vehicles. The 1947 models now available differ very little from the 1946 cars, and the automotive industry intimates that no drastic changes in design are contemplated for 1948. If this situation does obtain, it is safe to assume that for the next 2 years fuel requirements largely will follow the pattern of previous years. As better fuels are made available, the motorist will take advantage of the improved operation which they permit by advancing spark settings toward maximum power. The octane requirement of the cars in relation to the motor-method value of available fuels was indicated in Fig. 2. Octane-requirement data of this type represent the maximum road antiknock quality required, in terms of secondary reference fuels, regardless of the engine speed at which maximum knock may occur. In order to relate trends in engine design and the antiknock characteristics of fuels, it is necessary to go a little deeper into the way engines and fuels react to changes in speed.

The borderline method of road knock testing is an excellent tool for examining these characteristics. This method utilizes the relationship among ignition timing, engine speed, and fuel knocking tendency. It was adopted by the Coordinating Research Council as a standard road-test procedure for gasolines in 1941 and carries the official C.R.C. designation F-8A-943. Special equipment is necessary for conducting tests by the borderline method. The car must be equipped with a fixed distributor, that is, one which will not advance the ignition timing with engine speed, and a satisfactory means for adjusting it from the driver's seat. Likewise, there must be a suitable means for determining the spark advance while the engine is being operated on the road; an electronic or stroboscopic indicator is satisfactory for this purpose. There also should be a tachometer, conveniently located, since engine "revolutions per minute" rather than car "miles per hour" usually is used to indicate speed.

The procedure for determining the borderline curve for a fuel is as follows: The car first is operated for a sufficient length of time to insure that the test fuel has displaced completely the original tank fuel in the fuel system. Then, the ignition timing is set manually to a relatively low

*Hebl, L. E. and T. B. Rendel, S.A.E. 44, 210, 1939.

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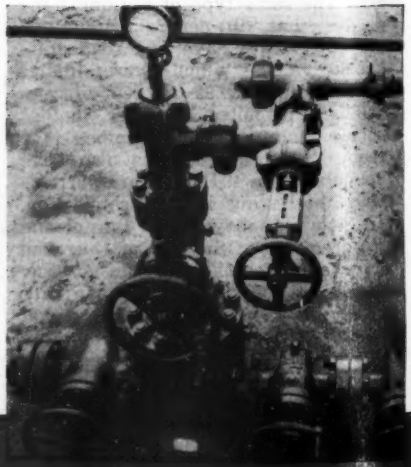

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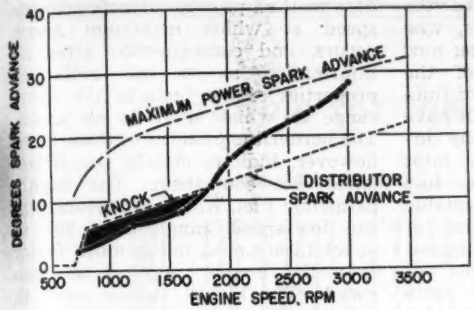
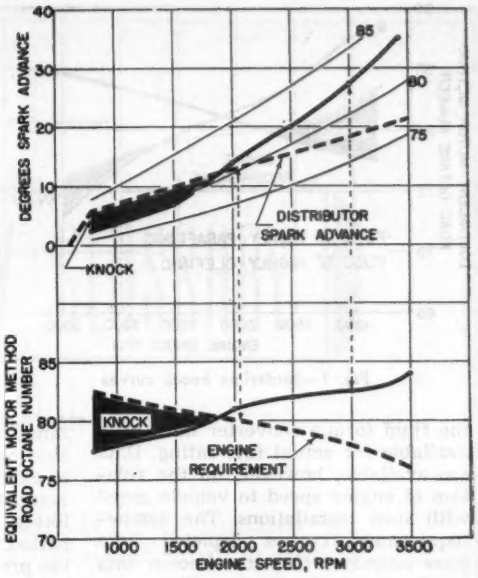


Fig. 3—(Left) Borderline knock curve. Method used to obtain curve for any fuel

Fig. 4—(Right) Estimation of equivalent road octane number from borderline curves



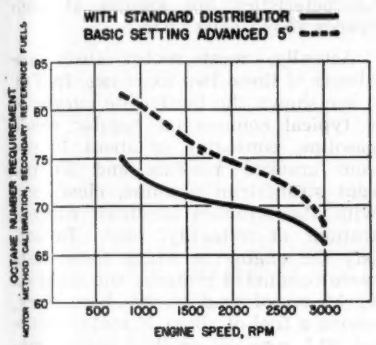
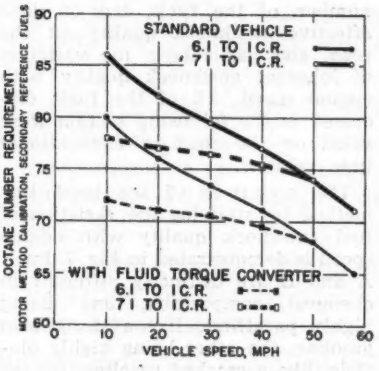


Fig. 5—(Left) Effect of advanced spark timing on octane requirement

Fig. 6—(Below) Effect of fluid torque converter on octane requirement



advance, usually 2° to 6° before top dead center. The car is slowed down to as low a speed as possible in high gear, generally about 500 to 600 r.p.m., and then accelerated with wide-open throttle; the speed at which the knock dies out is noted. This gives one point on the borderline curve—representing the two dimensions, spark advance and knock-die-out speed. The timing then is advanced 2° and the entire procedure repeated to give the second point on the curve. This process is continued until the complete curve has been established for the spark advance and engine-speed range under consideration. Care must be taken to prevent excessive knocking, since this will affect the reproducibility of the knock-die-out point.

Borderline test data usually are plotted as shown in Fig. 3. The light dotted line represents the distributor spark advance curve for the particular engine in which the tests were conducted. For a fuel not to knock in this car, it must be able to tolerate at least as much spark advance at all speeds as that produced by the distributor advance mechanism. Wherever the solid line representing the borderline curve for the test fuel falls below the distributor spark-advance curve, the engine is considered to be knocking. The borderline curve for this fuel indicates that it will knock at speeds in the range from 700 to 1,800 r.p.m.

The octane number of a fuel or the octane requirement of an engine at any engine speed can be obtained by also developing borderline patterns for a series of reference fuels which completely bracket the spark-advance range of the test fuels and the distributor curve. The borderline curves for the reference fuels are usually referred to as the reference fuel framework. Test fuel octane numbers are obtained by interpolation between their borderline curves and the reference fuel framework at any engine speed. Engine octane requirement at any speed is obtained by interpolation between the distributor spark advance curve and the reference fuel framework. These procedures are illustrated in Fig. 4.

In most of the conventional cars on the road the maximum octane requirement as determined by the borderline method occurs in the low-speed range. A typical curve is shown by the solid line in Fig. 5: As engine speed increases, the octane requirement of the usual current automotive engine decreases, however, so that at 2,000 r.p.m., or approximately 60 m.p.h., it probably requires a fuel some 8 or 9 octane numbers lower than it did at 800 to 1,000 r.p.m., or up to about 20 m.p.h. The octane numbers shown should be considered only as a qualitative guide. Actual levels will vary greatly depending upon the type of engine and its compression ratio. In general, the octane requirement curve for a valve-in-head engine is steeper than that of an LL-head engine, demonstrating that the former is relatively more severe at low speeds. However, both types usually have their greatest requirement in the low-speed range.

To carry this analysis beyond 1948, it is necessary to make some predictions as to the changes in automotive design which the industry contemplates making in its 1949 or 1950 models. Two design changes which will have substantial effect on engine-fuel requirements and which may be widely adopted by 1950 are higher compression ratios and improved automatic transmissions or torque converters. The automatic transmission has had considerable testing in actual driving since its adoption in two different forms by Chrysler and Oldsmobile in 1938 and 1939 respectively. The general interest of the public in devices which eliminate the conventional gear shift has encouraged all of the manufacturers to devote considerable effort to developing satisfactory automatic transmissions. Even the manufacturers in the low-priced field expect to use such mechanisms.

With this prospect in view, it is interesting to consider how the fuel requirements of the vehicles so equipped may be affected. In Fig. 6, the light solid line indicates the octane requirement over the speed range of a conventional vehicle with a 6.1 to 1 compression-ratio engine. It shows the typical high requirement at low engine speed, dropping off as speed is increased. The light dotted line is the estimated fuel requirement curve of the same engine in a vehicle equipped with a fluid torque converter. Since equipment of this type is still in the development stage, no passenger cars embodying

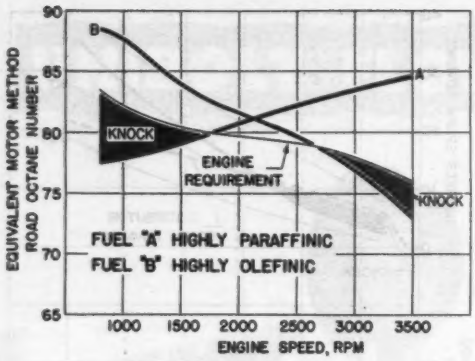


Fig. 7—Borderline knock curves

the fluid torque converter have been available for actual fuel rating. Data are available, however, on the relation of engine speed to vehicle speed with such installations. The octane-requirement curves depicted here were estimated from the known data on the standard vehicle with proper allowance for the alteration in the vehicle speed to engine speed relation introduced by the fluid torque converter. These curves, therefore, represent only the relative differences in octane requirement which may result from the use of such transmissions. It will be noted that the octane requirement of the vehicle drops noticeably owing to the fact that the fluid torque converter prevents loading the engine at low speeds where the conventional engine with conventional transmission is most critical. The octane requirement of such a vehicle is still greatest at low speeds, however, but in this case the decrease in requirement with increasing speed is slight. In other words, fluid torque converters tend to produce vehicles whose fuel requirements are lower and show less change with speed than those having the same engines with conventional transmission.

The fluid torque converter, however, decreases fuel economy, owing to slippage. Some of the automotive engineers, who have been working on new transmissions, are of the opinion that the use of fluid torque converters will have to be accompanied by increased compression ratos in order to retain fuel economy at an acceptable level. The information at hand indicates that in most instances an increase of approximately one ratio will be necessary to accomplish this.

In view of the probable octane requirements throughout the speed range of cars which will be available up to 1950, it is now of interest to examine the road antiknock characteristics of the fuels which are likely to be marketed during this period. It should be apparent from the previous discussion that the problem is not one of the basic octane number of the fuels, but of their effective antiknock quality on the road, and particularly the variation of inherent antiknock quality with engine speed. All of the fuels discussed in the following section were rated on the road in conventional type vehicles.

The usefulness of the borderline method for studying the variation of fuel antiknock quality with engine speed is demonstrated in Fig. 7. Fuels A and B are distinctly different in chemical composition, one being highly paraffinic, like a straightrun gasoline, the other being highly olefinic, like a cracked gasoline. By the older methods of knock rating gasolines on the road, both fuels are assigned the same road octane number. The older Uniontown method simply brackets the fuels in terms of maximum knock intensity between reference fuels of known octane number which knock just slightly less and slightly more than the test fuel. This method pays no attention to the speed at which maximum knock occurs, and consequently, gives no information as to the antiknock properties of the fuels in the speed range in which there is no knock. The borderline patterns of these fuels, however, indicate clearly the differences between them. The highly paraffinic fuel, A, knocks severely in the low-speed range from 800 to about 1,800 r.p.m., but is much better than the engine requires at high speeds. The highly olefinic fuel, B, has excellent low-speed antiknock characteristics but knocks at high speeds above 2,800 r.p.m.

Actually, most motor fuels are blends of these two extremes. In Fig. 8 are shown the borderline curves of a typical commercial regular grade gasoline, consisting of about 70 per cent cracked gasoline and 30 per cent straightrun gasoline, clear, and with the addition of three concentrations of tetraethyl lead. To satisfy the engine in which these tests were conducted requires the addition of 1.5 cc. of lead to this base stock, giving a fuel of about 76 motor method, 81.5 research method octane rating. On the road, this blend rates only 75 according to the borderline data, but this is satisfactory for the engine which, incidentally, happens to be an L-head type of 7.5 to 1 compression ratio. However, the important thing is not the equivalent road octane rating of this fuel at the speed of maximum knock, but the shape of the fuel's borderline curve. It will be noted that the fuel pattern tends to be quite flat over the lower part of the speed range. The engine-requirement curve, on the other hand, is steepest in this portion of the speed range. Thus, when the requirement of the engine increases, either as a result of carbon accumulation, or through spark timing adjustment as suggested by the dotted line on the figure, fuel of this type begins to knock at low speeds. Even with the addition of a full 3 cc. of lead, the tendency to low-speed knocking remains.

This is a characteristic of the majority of typical prewar motor-fuel stocks. A great deal of work has been directed toward determining the factors which influence the inherent road antiknock characteristics of fuels, and especially their low-speed performance since at present this is the range in which knocking is most critical. Experience has indicated that chemical composition of the lowest-boiling fractions of the fuel is of primary significance in this respect. This fact is demonstrated in Figs. 9 and 10. The series of fuels shown here was prepared by stripping the regular grade base stock just discussed through its C_5 fraction, the material removed constituting about 19 per cent of the total fuel. To 81 parts of

FUEL NO.	TEL CC/GAL	OCTANE NUMBER MOTOR	OCTANE NUMBER RESEARCH
A	0.0	66.0	69.5
B	0.5	70.0	75.0
C	1.5	76.0	81.5
D	3.0	79.5	85.5

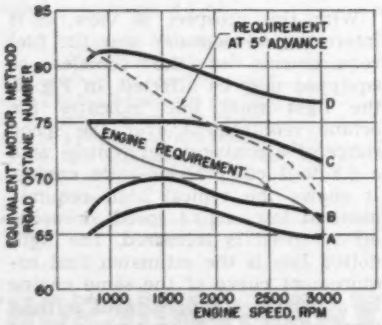


Fig. 8—Regular-grade gasoline—70 per cent cracked, 30 per cent straightrun

	FUEL	OCTANE NUMBER MOTOR	OCTANE NUMBER RESEARCH
A	REGULAR GRADE BASE	76.0	81.5
B	+N-PENTANE	72.0	79.5
C	+ISOPENTANE	76.5	83.0
D	+NEOHEXANE	76.5	85.5

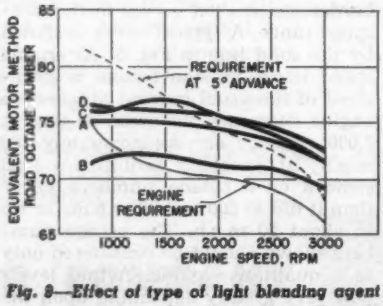


Fig. 9—Effect of type of light blending agent on low-speed antiknock quality—all fuels contain 1.5 cc. TEL per gallon

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P. O. Box 1260 **Tulsa, Oklahoma, U.S.A.**

FUEL	OCTANE NUMBER MOTOR	RESEARCH
A — REGULAR GRADE BASE	76.0	81.5
B — +PENTENE-2	76.5	86.5
C — +TRIMETHYLETHYLENE	77.0	89.0
D — +CYCLOPENTANE	78.0	84.5

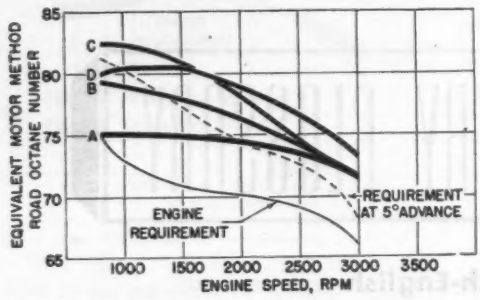

Fig. 10—Effect of type of light blending agent on low-speed antiknock quality—all fuels contain 1.5 cc. TEL per gallon

ENGINE	FUEL	TEL CC/GAL	OCTANE NUMBER MOTOR	RESEARCH	ENGINE
L-HEAD 1942 8.5 TO 1 C.R. 8 CYL.	A	0.0	82.1	95.4	VALVE-IN-HEAD 1946 8.0 TO 1 C.R. 8 CYL.
	B	0.5	82.9	96.9	
	C	1.5	83.6	98.7	
	D	3.0	84.4	100.0	

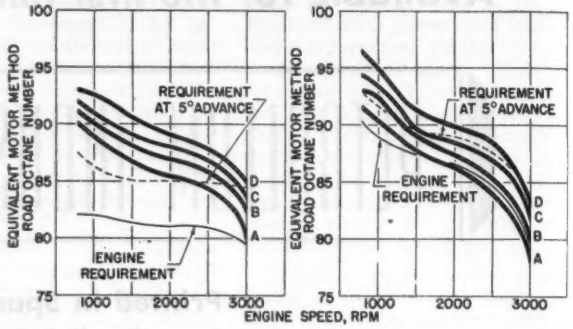

Fig. 11—High-sensitivity gasoline No. 1 made by catalytic cracking

the stripped base were then added 19 parts of each of the light blending agents to be tested.

The fuels were rated in the laboratory and on the road, clear, and with three concentrations of tetraethyl lead. For simplicity only the blends containing 1.5 cc. of tetraethyl lead per gallon are shown on these curves. It will be recalled that this is the lead concentration required in the original base stock to just satisfy the antiknock requirements of the test engine. The light paraffinic blending agents shown in Fig. 9 effected changes in the road antiknock characteristics of the base fuel which were roughly in line with the indicated changes in laboratory octane number. Thus, the substitution of n-pentane decreased the motor-method rating of the base by about four octane numbers, and there was a corresponding derating on the road throughout the whole speed range. Isopentane and neohexane, on the other hand, improved both the motor and the research ratings somewhat, and the road ratings of these blends were slightly better than that of the base fuel. In all cases, however, the borderline curves of the blends parallel the borderline pattern of the base fuel, so that when the octane requirement of the engine increases as suggested by the dotted line, even the isopentane and neohexane blends will knock up to 1,500 to 1,800 r.p.m.

Substantial Improvement

In contrast to the light paraffins, the substitution of the olefinic blending agents shown in Fig. 10 made a substantial improvement in low-speed antiknock performance of the base fuel. The normal olefin, pentene-2 was less effective than the highly branched trimethylethylene, of course, in keeping with the general superiority of branched chain compounds over their straight chain isomers. As a result of this improvement in low-speed performance, such fuels are not likely to give trouble when the requirement of the engine increases as suggested by the dotted line. The trimethylethylene blend is even better than the engine requires at this level, a fact which could not have been deduced from its motor method rating which is only 0.5 to 1 octane number better than that of the other blends.

The curve for the blend containing cyclopentane is included with the olefins as a matter of interest. Although cyclopentane is a naphthene and might have been expected to act more or less as the paraffins do, it actually has the same type of effect on low-speed performance as an olefin.

Fig. 11 presents the borderline curves for a high-sensitivity gasoline, No. 1, made by catalytic cracking, clear and with the addition of 0.5, 1.5, and 3 cc. of lead per gallon. Comparable data obtained both in an L-head and a valve-in-head engine are shown.

Not all high-sensitivity fuels are of this type, of course. Fig. 12 presents similar borderline curves at four lead concentrations for catalytically cracked fuel, No. 2, which has excellent high-speed antiknock characteristics. Although the borderline curves are quite flat in the low-speed range, the response of this fuel to tetraethyl lead additions, at low

ENGINE	FUEL	TEL CC/GAL	OCTANE NUMBER MOTOR	RESEARCH	ENGINE
L-HEAD 1942 8.5 TO 1 C.R. 8 CYL.	A	0.0	79.6	88.8	VALVE-IN-HEAD 1946 8.0 TO 1 C.R. 8 CYL.
	B	0.5	82.2	91.9	
	C	1.5	85.2	94.6	
	D	3.0	87.9	96.7	

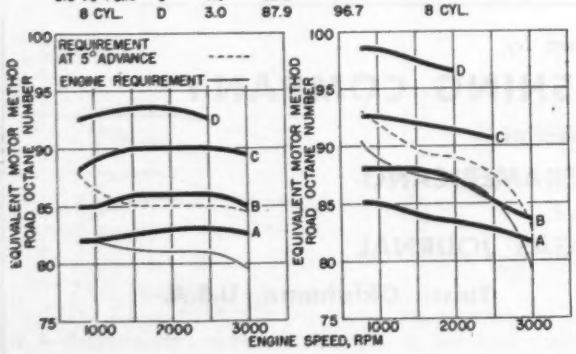

Fig. 12—High-sensitivity gasoline No. 2 made by catalytic cracking

ENGINE	FUEL	TEL CC/GAL	OCTANE NUMBER MOTOR	RESEARCH	ENGINE
L-HEAD 1942 8.5 TO 1 C.R. 8 CYL.	A	0.0	75.2	85.3	VALVE-IN-HEAD 1946 8.0 TO 1 C.R. 8 CYL.
	B	0.5	78.3	88.5	
	C	1.5	80.8	91.7	
	D	3.0	83.0	94.3	

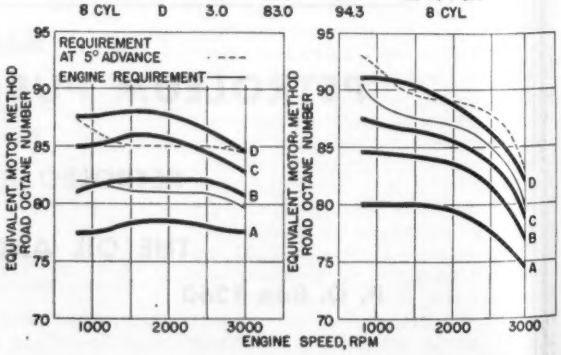

Fig. 13—High-sensitivity gasoline No. 3 made by thermal cracking

speeds as well as high, tends to compensate for the inherent weakness shown by the clear fuel. With the addition of 1.5 cc. of lead, such a fuel should be satisfactory over the whole speed range in both the L-head and valve-in-head engines shown here, even if octane requirement should increase as a result of spark-timing changes or the installation of a fluid torque converter coupled with a higher compression ratio engine.

Certain types of thermal cracking also give high-sensitivity gasolines which approach the desirable antiknock properties demonstrated by fuel No. 2. Fig. 13 presents the borderline curves for high-sensitivity gasoline No. 3 made by thermal cracking. For comparison with the previous fuels, the curves are shown as determined in the same two engines although this gasoline is 5 to 7 octane numbers lower in clear motor-method rating. It is hardly fair, therefore, to consider its antiknock properties in relation to the requirements of the engines. If the shape of the borderline curves rather than their octane levels is examined, however, it will be seen that fuel No. 3 tends to approach the characteristics of fuel No. 2 on the road. The borderline patterns of the clear fuel show it is inherently somewhat weak at both low and high speeds, but its good road lead susceptibility compensates to a large extent for these inherent defects. With the addition of 3 cc. of lead, this fuel will satisfy the requirements of the two types of engines when essentially free from combustion chamber deposits and is nearly good enough to withstand increases in engine requirement due to advanced spark timing.

Some interesting indications can be derived from a consideration of the data shown in Table 2 for the leaded blends of these three fuels which appear to best satisfy the projected requirements of the test engines. It is an interesting point that the blends required to satisfy the engines have essentially the same motor-method octane number, about 85. A certain degree of sensitivity obviously is necessary in order to hold this motor method level on the road. It would appear, however, that if this sensitivity is gained at the expense of a drastic decrease in lead susceptibility, as in fuel No. 1, the advantage of enhanced road rating at low speeds is no guarantee of satisfactory performance over the speed range.

TABLE 2—SUMMARY OF ANTIKNOCK DATA

	High sensitivity gasoline		
	No. 1	No. 2	No. 3
Tetraethyl lead, cc. per gallon	3.0	1.5	3.0
Octane number:			
Motor method	84.4	85.2	83.0
Research method	100.0	96.7	94.3
Equivalent road:			
1,000 r.p.m., L-head	92.5	89.0	87.5
1,000 r.p.m., valve-in-head	95.0	92.5	91.0
2,500 r.p.m., L-head	88.0	90.0	86.5
2,500 r.p.m., valve-in-head	88.5	90.5	86.5
Laboratory sensitivity	15.6	11.5	11.3
Laboratory lead susceptibility	2.3	8.3	7.8

TABLE 3—HYDROCARBON-TYPE ANALYSIS OF FUELS 1, 2, 3

	High sensitivity gasoline		
Light cut, i.b.p. to 140° F.:	No. 1	No. 2	No. 3
Per cent olefins	73.0	21.2	43.0
Per cent aromatics	...	...	...
Per cent paraffins	27.0	78.8	57.0
Per cent naphthenes	...	...	...
Per cent of total fuel	14.3	22.0	21.3
Octane No., motor	90.2	91.2	86.7
Octane No., research	Over 100	99.5	99.0
Heavy cut, 248° F. to end point:			
Per cent olefins	24.0	1.2	20.8
Per cent aromatics	64.2	54.0	36.1
Per cent paraffins	2.0	4.9	5.7
Per cent naphthenes	10.0	39.9	37.9
Per cent of total fuel	48.8	51.3	39.9
Octane No., motor	73.6	77.9	71.0
Octane No., research	81.0	87.5	79.3

An analysis of the hydrocarbon compositions of these three fuels furnishes better evidence of their relative road antiknock and road lead susceptibility properties. A good deal of experience along these lines has indicated that it is the composition of the lightest and heaviest fractions of the fuel which is of primary significance. Up to the present time, no correlations of road performance with the hydrocarbon-type compositions of more specific cuts have proved practicable. In Table 3, therefore, only the analyses of the lightest fraction boiling up to 140° F., and of the heavy portion of the gasoline boiling above 248° F., have been listed.

These data show that fuel No. 1, which has the remarkable low speed performance, has 73 per cent olefins in its lightest fraction. Fuel No. 2 which is particularly good at high speeds and has excellent road lead susceptibility has almost no olefins in its high boiling fractions. Many data are available to substantiate this evidence that low-speed performance improves with increasing olefin content of the lightest fractions, and high-speed performance and road lead susceptibility improve as the olefin content of the heavy fractions is reduced.

Fuel No. 3 which falls between these two limits in road performance has about 43 per cent olefins in the front end and about 20 per cent olefins in the heavy end. It seems unlikely that the drop of only 4 per cent in heavy olefins shown by fuel No. 3 in comparison to fuel No. 1 could account entirely for the difference in high-speed performance and road lead susceptibility demonstrated. It seems more logical that although the primary thing is to keep the olefin content of the heavy fractions low, it is of secondary importance to see that the preponderance of hydrocarbons in this portion of the boiling range are those which respond well to additions of tetraethyl lead. Generally speaking, the paraffins and naphthenes have the best lead susceptibility, but previous work indicates that the higher-boiling, highly alkylated aromatics also respond well

TABLE 4A—HYDROCARBON-TYPE ANALYSES, TYPICAL MOTOR-FUEL COMPONENTS

	Straight-run gasoline	Mixed-phase thermal cracked	Vapor-phase thermal cracked	Catalytic polymer	Thermal polymer
Approx. boiling range, °F.	105-270	100-415	100-405	115-380	105-370
Light cut, i.b.p. to 140° F.:					
Per cent olefins	0.5	36.0	70.0	100.0	34.0
Per cent aromatics	...	...	...	...	...
Per cent paraffins	99.5	64.0	30.0	...	66.0
Per cent naphthenes	...	...	...	...	...
Per cent of total fuel	20.2	20.7	21.3	2.1	43.2
Heavy cut, 248° F. to e.p.:					
Per cent olefins	*1.0	*31.0	*43.0	83.0	*17.0
Per cent aromatics	8.0	5.0	25.0	17.0	41.0
Per cent paraffins	44.2	9.0	17.0	...	4.0
Per cent naphthenes	47.8	55.0	15.0	...	38.0
Per cent of total fuel	7.2	53.3	50.7	29.0	16.8

*Cut 325° F. to end point.

TABLE 4B—HYDROCARBON-TYPE ANALYSES, TYPICAL MOTOR-FUEL COMPONENTS

	Poly-formed gasoline	Catalytic cracked gasoline 1	Catalytic cracked gasoline 2	Catalytic cracked gasoline 3	Hydro-formed gasoline
Approx. boiling range, °F.	100-425	100-400	90-400	95-400	150-365
Light cut, i.b.p. to 140° F.:					
Per cent olefins	43.0	73.0	21.2	56.8	7.5
Per cent aromatics	...	...	...	...	...
Per cent paraffins	57.0	27.0	78.8	43.2	84.3
Per cent naphthenes	...	...	...	...	8.3
Per cent of total fuel	21.3	14.3	22.0	20.8	2.0
Heavy cut, 248° F. to e.p.:					
Per cent olefins	20.8	24.0	1.2	12.2	1.4
Per cent aromatics	36.1	64.2	54.0	46.6	85.1
Per cent paraffins	5.7	2.0	4.9	21.4	7.8
Per cent naphthenes	37.9	10.0	39.9	19.8	5.7
Per cent of total fuel	39.9	48.8	51.3	37.9	31.7

to lead additions. This combination of factors appears to justify the superiority of fuel No. 3 over fuel No. 1 at high speeds. The latter has a combined paraffin-naphthene content in the heavy fraction of only 12 per cent against about 44 per cent in the former. There is no indication in these data as to what percentage of the 64 per cent heavy aromatics in fuel No. 1 and the 36 per cent heavy aromatics in fuel No. 3 might be of the highly alkylated type having good lead response, but this factor undoubtedly is significant.

Application to Refinery Operation

Knowledge of the road antiknock characteristics of gasolines in relation to their hydrocarbon compositions can be used advantageously by the refiner not only in determining the most desirable premium and regular-grade blends to make but also in deciding on the types of new plant equipment to be added. A general approach to the utilization of this knowledge for these purposes can be gained by an analysis of the data presented in Table 4, Parts A and B, which give the hydrocarbon compositions of the i.b.p.-140° F. and the 248° F. to end point fractions of a number of present-day motor fuel components. A consideration of these data in the light of the previous discussion of the influence of hydrocarbon composition on the road performance of fuels points out some interesting facts about refinery operations.

Most of the smaller and a number of the larger refineries have available for motor-fuel production only straightrun gasoline, mixed-phase thermally cracked gasoline, and catalytic polymer. The hydrocarbon analyses of typical examples of these components show that blends of these full-boiling-range stocks tend to be quite paraffinic in the light fractions. Straightrun contains almost 100 per cent paraffins and the mixed-phase cracked gasoline contains 65 per cent paraffins in this range. The percentage of polymer boiling below 140° F. is so small that it has comparatively little effect in spite of being completely olefinic. As a result, such blends tend to be poor at low speeds on the road. In refineries where vapor-phase thermally cracked gasoline is available, motor-fuel blends generally show better low-speed performance owing to the fact that this component is generally about 70 per cent olefinic in the light fractions.

In regard to high-speed performance and road lead susceptibility, the typical blends of straightrun, mixed-phase cracked, and polymer probably will be satisfactory owing to the highly saturated character of the heavy portions of the first two components which constitute the greatest share of the fuel. The extreme olefinicity of the polymer tends to offset this somewhat but usually does not produce a critical condition. The inclusion of vapor-phase cracked gasoline, however, may throw the balance into the critical range if present in large volume, since this component is highly unsaturated in the heavy fractions.

If vapor-phase cracked gasoline is used instead of mixed-phase, it would be highly desirable also to be able to substitute thermal polymer for catalytic polymer. Thermal polymer, in contrast to catalytic polymer, has very good leal susceptibility as the hydrocarbon data would indicate. This would help the critical high-speed condition introduced by the vapor-phase gasoline.

Until the war these components constituted the major portion of all motor-fuel blends. Now, the components shown in Part B of Table 4 are assuming more and more significance. It is important that refiners contemplating the addition of one of the new types of units recognize exactly how the new fuel component will contribute to the road performance of older blending stocks.

Polyforming, which is presently used primarily for reforming heavy gasoline, produces a fuel quite a lot like thermal polymer in hydrocarbon composition. Polyforming is a thermal operation in which the liquid charge is cracked in admixture with

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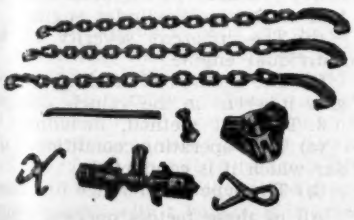

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C_3 and C_4 gases. Polyformate is somewhat more unsaturated in the front end than thermal polymer which enhances its low-speed performance. Though not sufficiently olefinic to equal the low-speed performance of vapor-phase cracked gasoline, polyformed gasoline offsets this by having better road lead susceptibility, and usually a higher octane rating. Being primarily a reforming operation, it is not entirely fair to compare polyforming to thermal cracking of heavier stocks.

The three catalytically cracked gasolines presented in Table 4, Part B, have been chosen to demonstrate the wide variations in hydrocarbon composition, and, therefore, road performance, which are obtainable with this processing method depending upon the type of charging stock, the type of catalyst, the cracking temperature, and the severity of the operating conditions selected.

Hydroforming, though a catalytic-cracking operation, produces a far more specific product owing to the type of charging stock and the circulation of free hydrogen. It is almost entirely paraffinic in the front end, and almost entirely aromatic in the heavy fractions. Road data show it to have unusually good road lead susceptibility at all speeds.

The Fuel-Engine Relation

The preceding discussion of the road antiknock characteristics of fuel components as a function of their hydrocarbon compositions, and the relation of these inherent fuel properties to the probable antiknock requirements of vehicles over the next few years has been treated in its simplest terms. It would be a serious omission to conclude this presentation without mentioning the influence of certain engine factors and test method variables on the data discussed. The fuel-engine relation actually has three aspects:

1. The fuel, including:

(a) The inherent antiknock qualities of the different types of hydrocarbons.

(b) The blending characteristics of these hydrocarbons in the individual mixtures.

(c) The effect of tetraethyl lead additions on the finished blends.

2. The engine, including:

(a) The distribution of light and heavy fractions in the induction system of the multicylinder engine.

(b) The inherent severity of the individual engine.

(c) The method of loading the engine inherent in the vehicle design.

3. The test method, including:

(a) The operating conditions under which it is conducted.

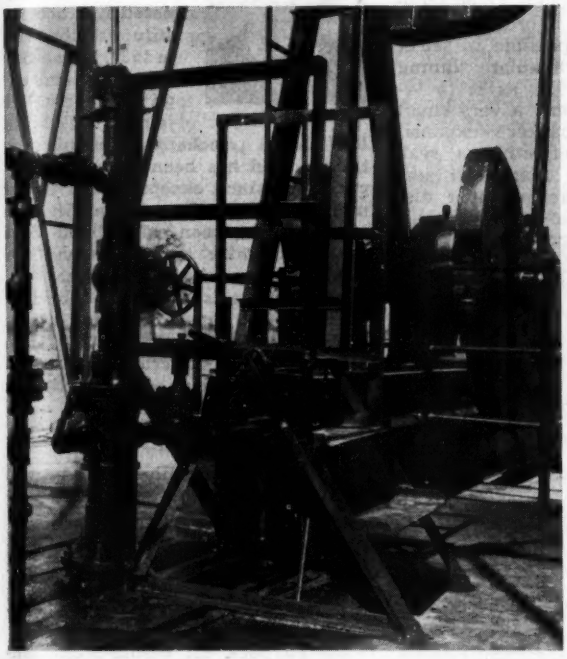
(b) The type of reference fuel used.

All of these factors operate simultaneously to determine the characteristics assigned to a given fuel or engine.

OPERATING IDEAS

Portable Well-Head Platform

ACCESS to the stuffing box on a pumping well where the christmas-tree head extends well into the air is secured through the use of a light, welded stair and platform which normally is set close to the well. Light tank plate is used for the steps, which are formed with end flanges to stiffen them and provide area for welding to



sloping uprights. The platform is of the same material, laid into 1¼-in. angle-iron side members, with the same material used to form the railings. All joints are welded except those holding the well side of the two railings, which are bolted so that they can be removed to permit extension of the horizontal members to contact a similar unit—brought from an adjacent well—when servicing operations are required. The unit is amply strong to support two men, is readily moved aside if access to the cellar is required, and for upkeep requires only an occasional coat of paint. It may be made up entirely from scrap tank and derrick material, and readily sluiced down with a hose if it becomes fouled or paraffin coated.

Engine Starting Stand

WHEN the engine driving the pump is set too high for convenient cranking from the ground, provision of a firm stand for the switcher is good insurance against accident. One company makes up a heavy stand which not only provides a firm footing, but is so heavy that it is not apt to be dragged away for use elsewhere. The base is made up of two pairs of 10-in. scrap I-beams, some 2 ft. in length. One pair is firmly welded atop the other, to form a square unit, with a pair of 12-in. pieces of 2-in. timber bolted on the upper pair to form a platform. The assembly is heavy enough to stand firmly in place, and to resist displacement. Planks are set across the tops of the lower

pair to form a shelf on which may be stored replacement parts for engine or pump, a board at the back checking flow of water from the engine concrete base onto the material stored there.

Portable Measuring Line Trailer

A SELF-CONTAINED measuring-line unit is mounted on a two-wheeled trailer to permit quick and accurate depth determinations in one field. A single-cylinder gasoline engine is gear-connected to a reel which carries the line, while a degageable hand crank provides for manipulation for closing a run. The tongue of the trailer unit is provided with two heads, one of which screws into the pipe collar to take the trailer hitch for towing the unit behind car or truck. The other head carries the guide sheave, set on a swivel bearing which permits it to swing sideways as the line spirals across the reel. Six pin ends from scrap ¾-in sucker rod are spotted around the edge of the platform, and serve to hold as many short posts of sucker rod which, in turn, slip into sockets for the light framework for carrying the tarpaulin. A heavy block under the tongue, and a screw or ratchet jack on a sliding unit at the rear permit the platform to be leveled properly and adjusted so that vibration set up by the rapidly spinning reel is damped out before causing damage.

Packer Problems in West Texas

by T. H. Dwyer

FOR the purpose of this paper, a packer will be defined as a tool for isolating a portion of the space in a well. The subject may be divided into two logical headings: Casing-packer problems and open-hole problems. The discussion under each of these headings will be treated under the following subheadings:

1. Problems readily solved with available packer equipment.
2. Problems solved with some difficulty using available packer equipment.
3. Problems apparently solvable by packers if improved equipment were available. (Such problems as presently handled by other methods.)
4. Recommended practice for running, setting, and removing packers.

Casing-Packer Problems

Packers used to solve problems falling in this category are essentially precision tools designed to known tolerances. Knowing the drift diameter of the casing through which these packers must be run in order to reach setting depth, it is possible to select a packer of small annular running clearances, often as low as ¼ to ⅛-in. In this manner, only a very small percentage of the packer's expansibility is used in effecting a seal, thereby allowing a firm wall seal without undue packer element distortion. Moreover, the operator is allowed sufficient operational flexibility by the use of either hookwall, anchor, or pressure actuated packing elements.

T. H. Dwyer is associated with Shell Oil Co., Inc., at Midland, Tex. A native of Houston, he was graduated by Rice Institute of that city in 1937, with a B.S. in mechanical engineering. He joined Shell in 1937 as a mechanical engineering trainee, and has been with the company ever since, except for a 4½-year military leave. He rejoined Shell in 1945 and has been at Midland since that time, with the exception of a short assignment in Louisiana.

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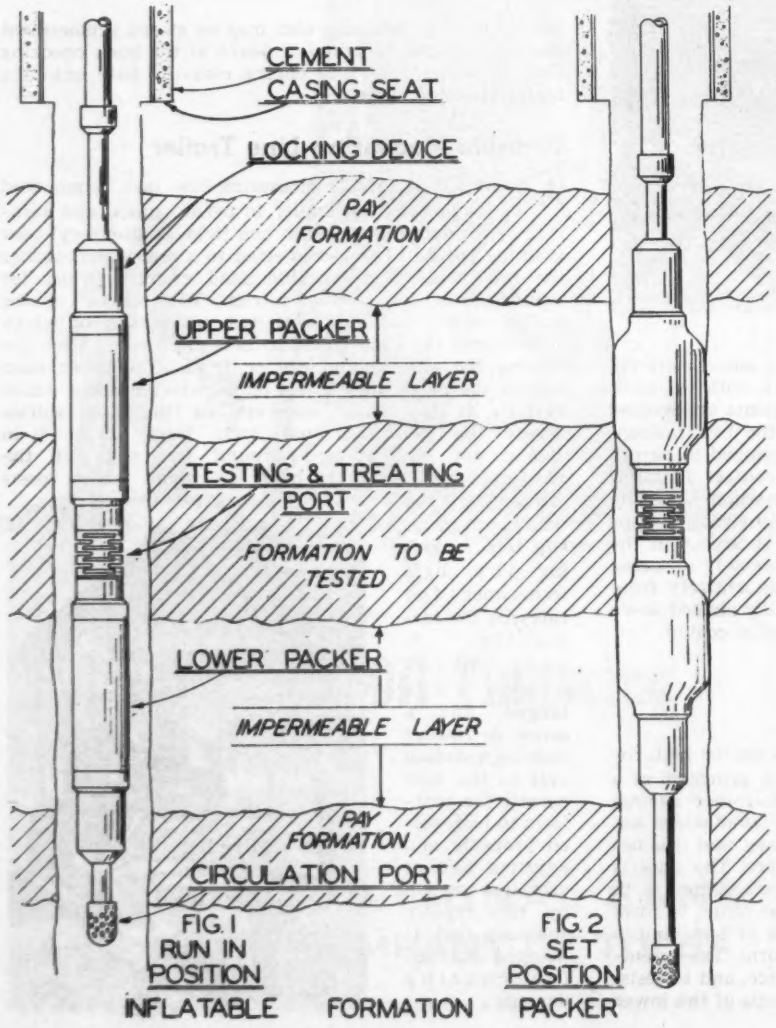

1. Problems readily solved with available packer equipment.

This group involves equipment employing packers to assist in the performance of the following operations:

(a) To pack off between the tubing and casing in an attempt to prolong the flowing life of a well.

(b) To pack off casing-tubing annulus for gas-lift installations.

(c) To keep excessive pressure from the casing in high-pressure gas wells.

(d) For packing off and filling the casing-tubing annulus with oil as a means of retarding corrosion.

(e) To cement liners.

(f) To obtain production tests of formations encountered in drilling wells after water string has been set and before maximum depth is determined.

(g) To test the effectiveness of a cement job after casing has been set.

(h) To locate casing leaks.

Field records indicate that packers thus applied perform their intended functions satisfactorily and are accurately set without difficulty. Removal of these packers after long periods in the hole presents the only problem not entirely within the control of the operator. In this group, most cases of "stuck" packers result from one or both of the following causes:

1. Adherence of packer element to casing wall.
2. Corrosion on packer operating mechanism.

The vulcanizing effect of temperature on rubber and rubber-impreg-

nated packing elements is widely known; however, recent development of "rubber compounds" has made available packing elements capable of a satisfactory service at temperatures as high as 315° F. These improved materials have greatly reduced the tendency of packer elements to adhere to the casing wall in the low-temperature applications of West Texas wells. For example, the bottom-hole temperature in wells producing from less than 11,000 ft. is only in the vicinity of 150° F.

Corrosion of the metal operating parts of packers can be reduced to negligible proportions by the use of corrosion-resistant alloys. Nevertheless, corrosion products falling from above have, in some cases, impaired the action of the packer mechanism causing it to fail to release.

In order to facilitate running in and removal, some packers in this class are provided with circulation bypasses. These circulation bypasses can be closed by sealing off the inner passage independently of the main seating elements. Such bypasses permit running larger-sized packing elements in the casing and higher running speeds. Pulling of circulation-type packers is facilitated by the fact that the smaller inner seal is easily opened against high differential pressure. This permits equalization of pressure across the packer and consequent removal without danger of swabbing action. Corrosion products falling from above and plugging the circulating passages, may result in failure of the valve to operate thereby causing a difficult packer removal job.

To eliminate the necessity of removing the entire packer assembly each time the tubing is pulled, some operators run permanent-type hook-wall retainer production packers in which the tubing is seated and sealed by a packing sub or a seal nipple. The drillable packer body is provided with double slips and is permanently set in the casing until removal becomes necessary. The tubing seals in the packer body and can be extended below the packer setting point by the use of flush-joint tail pipe. Thus, the tubing can readily be removed and rerun in the well without the necessity of pulling the packer body.

2. Problems solved with some difficulty using available packer equipment.

This group involves equipment employing packers to assist in the performance of the following operations:

(a) Zone separation in multiple-completion wells.

(b) Squeeze cementing.

(c) Acidizing.

Field performance of packing equipment thus applied has been substantially satisfactory. For zone separation in multiple-completion wells, permanent-type retainer production packers are generally used. When this packer is used alone, there has been some question of leakage owing to extremely high differential pressure in favor of the lower zone. This pressure differential may cause actual lifting of the tubing and result in leakage past the seat nipple. Although this condition is likely to occur only in extreme cases in which the upper-zone pressure is materially reduced by swabbing or other means, a manufacturer is now offering a retainer packer with a latch-on device attaching the tubing to the packer in such a manner that it cannot be raised off its seat by differential pressure. This device is comparatively new and has yet to be thoroughly proved in West Texas.

The packer problems encountered with squeeze-cementing operations usually are a result of one or both of the following causes:

1. Length of time in which the operation must be performed.

2. Sensitivity of some highly designed packing tools.

The decrease in the setting time of cement as a result of its dehydration under high squeeze pressure is widely known. On squeeze-cementing jobs, the relatively short time available to complete the operation rarely permits the operator to correct any difficulties that may be the result of malfunctioning of the retrievable cementing tool. This being the case, the retrievable tool used must operate without undue difficulty in order that excess cement may be circulated out of the run-in string. In addition, the packer must release promptly so that it may be moved a safe distance up the hole to minimize the danger of cementing the tool in place. Recent models of retrievable cementing tools perform satisfactorily; however, as a safety measure, they are provided with a releasing mechanism which allows the upper nondrillable part of the tool to be removed from the hole in the event the drillable packer element sticks.

Some difficulty has been experienced with the permanent-type drillable cement retainer as a result of failure of the internal parts to function. With one type of hydraulic pressure operated retainer, "pumping out" of the internal parts is not uncommon. These difficulties can in most cases be traced to failure by the operator to observe and follow the manufacturer's instructions and to careless, high volume circulation or application of excessive pressures.

3. Problems apparently solvable by packers if improved equipment were available.

To the knowledge of the writer, there are no applications of oil-well casing packers in West Texas for which adequate equipment is not available.

4. Recommended practice for running, setting, and removing packers.

(a) Selection and checking of equipment. In selecting the packer to be used for a job, only proven designs and materials should be considered. Anchor packers should be used only for those "permanent" installations where short tail pipes are possible and where no danger exists of sand or cutting accumulation around the tail pipe. As a safety precaution, it is advisable to have a safety joint on the anchor pipe immediately below the packer so that the packer can be disconnected should the anchor pipe stick. In all cases, care must be taken to use a tail pipe of sufficient column strength. This is important because in the event of decline in well pressure the anchor pipe must be capable of withstanding any casing-tubing annulus fluid load on the packer.

Before running the equipment into a well, the operator should familiarize himself with exactly how the individual mechanism performs, know what shear pins are included, their shearing strength, how the releasing mechanism operates, etc. In addition, the equipment should be carefully checked for proper o.d. sizes, condition of mechanism, etc.

(b) Mechanical condition of the well. It is essential that the hole be clean, particularly at the setting point of the packer. A bit and reamer should be run in old wells prior to running a packer in order to remove cement, corrosion products, burrs from gun perforating, or any other internal obstructions from the interior wall of the casing down to the setting point.

The use of a rotary casing scraper or reamer is recommended prior to running or setting a packer in new wells in order to remove any cement sheath possibly adhering to the casing inside walls.

(c) Running packers. For running and setting packers, a weight indicator in good condition is essential. Application of any torque at the surface that would tend to trip the mechanism while running in the well should be avoided. Noncirculating packers should be lowered into the hole slowly and with great care to minimize the pressure differential across the packer caused by their small annular clearances. While lowering the packer, the weight indicator should be carefully observed. At the first sign of decreasing weight, the rate of lowering should be reduced.

The safe rate of lowering will vary with the make and type of packer. Even if high lowering speed is possible, it is inadvisable to lower rapidly as the sudden impact on an obstruction or accumulation of trash can set some packers before the string can be stopped.

If a packer trips while being lowered in the hole, it is generally advisable to remove and examine the equipment before attempting to set it. It is apparent, therefore, that the

extra time taken to lower packers at safe speeds is economically spent.

4. Setting packers. Packer mechanisms should be of the type which set or release by right-hand rotation on the surface. In crooked holes this feature is essential because, with left-hand released packers, wall friction can cause unscrewing of the actuating string without tripping the packer. In the case of either right or left-hand release mechanisms, wall friction can be materially reduced by gradual lowering or raising the string while the releasing torque is applied.

After the mechanism has tripped, it is generally advisable to lower the sealing weight gradually onto the packer. In the case of hook-wall packers, it is advisable to lower about 50 per cent more weight than will be left on the packer after hanging in order to test the slip hold on the casing.

For complex packing devices, care should be taken to follow the instructions given by the manufacturer. Packers of this type are sensitive and careless handling will prevent their operation. It is recommended that those charged with handling and setting these packers become familiar with the manufacturer's instructions and with the importance of closely following these instructions.

5. Removing packers. The advice of the manufacturers of drillable non-retrievable equipment will probably be of some help when it is necessary to remove such packers from the well.

Most hook-wall and anchor packers present no problem of removal, particularly if the packer has been set only a short period of time. As mentioned earlier, the circulation-type packer is usually easier to unseal since the circulation valve can be used to equalize the pressure above and below the packer. With pressures equalized, the full unseating force is applied to the packer mechanism and elements alone.

For difficult cases of stuck packers, circumstances and conditions vary too widely to permit successful removal by any routine procedure. In general, the capacities of the equipment available on the job and the operator's ingenuity and willingness to "get rough with it" determine the methods applied.

All packers, particularly the non-circulating type, should be pulled from the hole slowly to lessen any tendency for the packer to swab the hole.

Open-Hole Packer Problems

Packers normally used to solve problems falling in this category must be designed to allow maximum expansibility of the packing element since their purpose is to effect a seal on the wall of the hole whose diameter is usually not definitely known. In addition, the sealing element should be semifluid, of low internal resistance to flow, resilient, and tough. It must expand a relatively large amount and effectively seal against a surface which may be non-uniform in character. It must return to its original shape when the load is removed in order to facilitate removal from the hole.

Although some models of open-hole packers are designed to operate on the hook-wall principle with the casing slips operating some distance above the sealing element, the majority of the packers commercially available operate on the anchor principle.

Since open-hole packers must effect a seal under very difficult working conditions, they are usually constructed of the best materials obtainable.

1. Problems readily solved with available packer equipment.

This group includes packers to accomplish the following:

(a) To segregate the gas-bearing from the oil-bearing portion of a pay section when both are exposed to the open bore hole below the casing seat and are separated by an impermeable layer.

(b) To segregate the water-bearing from the oil-bearing portion of a pay section when both are exposed to the open bore hole below the casing seat and are separated by an impermeable layer.

(c) Selective acidization of the lower of two formations exposed to an open bore hole of a well below the casing seat.

Formation packers once were used extensively to shut off gas and water in open hole in the West Texas area but this practice is now declining. The use of packers for these purposes exposes the casing-tubing annulus of the well to high-pressure gas and, in rare cases, to formation water which in turn, accelerate corrosion of the casing and tubing. Corrosion in some of the older wells has been severe, causing holes in the well casing and tubing. In order adequately to protect wells where this has occurred, it has been necessary to run a complete casing string inside the damaged string. As a result, some operators are now reworking wells with a long predictable life by removing these formation packers, cementing a liner and perforating opposite the oil-bearing formation. This operation effectively seals off the water or high-pressure gas from the casing-tubing annulus of the well.

Although the use of formation packers for water and gas shutoff in long-life wells proved uneconomical for the reasons outlined above, packers thus used satisfactorily perform the purpose for which they are intended. Where a water or gas shutoff is desired in a well with a short predicted life, formation packers continue to be used to advantage. Usually, these packers are located and set without difficulty since the impermeable layer serves as an excellent packer seat.

As in the case of production packers described earlier, removal of these packers after long periods in the hole presents the only problem over which the operator has little control. Removal is complicated by the same causes as mentioned under casing packers. Morever, formation packers are more difficult to remove since they usually include an anchor which frequently is "frozen" in the hole by an accumulation of loose particles around it. Furthermore, in the case of open-hole anchor packers, loose particles falling from the open hole above the packer cause failure of the mechanism to release when removal is attempted. In view of the large amount of nondrillable material left in the hole, removal of stuck formation packers can be very costly to the operator.

Formation packers used for selective acidizing are generally of the anchor type and include a circulating valve. Their field performance record is good, and, in the usual case, these packers are removed without difficulty since they remain in the hole only a relatively short time. Also, the action of the acid tends to soften and dissolve any accumulation which might settle around the anchor pipe. For high-pressure acid jobs a balancing pressure is usually applied above the packer to assist in maintaining a seal against the lifting force resulting from the acid pressure on the packer's lower surface.

In order to facilitate removal of formation packers used to acidize and test in the Fullerton field, one operator modified the design of a conventional formation packer to permit a greater reduction in packer element diameter at the time an attempt is made to pull the tool. The modification permitted the large-size mandril to be pulled from inside the packer element, and this allowed the element to contract around a smaller inner mandril before an attempt was made to pull the packer up the hole. The use of this modified unseating arrangement has in some cases lessened the difficulty formerly experienced in pulling packers. Although this arrangement was first used in 1942, a packer embodying this modification has not yet been produced in large quantities. As a result, this promising device has yet to be thoroughly proved in the field.

This modified unseating arrangement has recently been further improved to permit the large mandril to be forced upward by hydraulic pressure applied to the run-in string at the surface. If proved in the field, this change would permit further reduction in the pull normally applied in the run-in string at the surface to unseat the packer.

2. Problems solved with some difficulty using available packer equipment.

This category includes the use of formation testing or drill-stem testing equipment. In view of the significance of the data obtained, formation testing is the most important service performed by packers in this area.

Anchor packers are normally a part of the open-hole formation-testing equipment used in the West Texas area. Cone or "rathole" packers were once widely used with this equipment but this practice has been almost completely discontinued for the following reasons:

(a) Necessary to reduce hole size to form packer seat.

(b) Necessary to anticipate an interval to be tested in order to properly locate rathole.

(c) Necessary to ream hole to full size in order to drill ahead after test is completed.

The use of open-hole formation-testing equipment has increased rapidly during the last 5 years. Although field-performance records indicate significant reductions in the number of failures of the packer elements of these tools, the percentage of failure remains undesirably high. One operator recently investigated this problem in an attempt to further reduce formation test failures. Tables 1, 2, and 3 show some of the data compiled as a part of this investigation. Table 1 indicates the trend by tabulations of the number of tests attempted and percentage of failures experienced over a 3-year period. Table 2 indicates that packer failures are named by operating personnel as being responsible for the majority of formation test failures. In Table 3, failures are classified by the formation and depth at which they occurred in an attempt to establish some general rules for expected packer behavior. As a result of this investigation, it was concluded that formation-testing packers tend to fail more easily at greater depths but no conclusions were reached relative to the effect of any particular formation on the packer's ability to seal. These data are included only to serve as a spot check in formation testing equipment and, in view of their incomplete nature, it is not felt justified in an attempt to use them as a basis for further conclusions.

Although opinions vary widely on the subject of formation testing, it is certain that a number of factors within the operator's control are at least partially responsible for some of the unsuccessful tests normally attributed to packer failure. Specifically, it appears that a number of failures could be eliminated if the hole and mud were maintained in proper condition. Also, accurate depth measurements are essential in order to make certain the anchor is firmly seated on bottom before an attempt is made to open the tool.

Packer seats for formation tests are selected by reference to drilling-time information, core date, drill cuttings, and other pertinent drilling information. Although this practice is generally satisfactory, occasionally there are cases where additional information is needed in order to locate a good packer seat. This additional information is usually obtained from caliper surveys and well logs.

Use of caliper surveys to assist in the selection of a suitable packer point is increasing. At present, caliper surveys are usually run to select a packer seat only after one or more attempted tests have failed with seats selected from drilling information alone. Although the operator is not billed when a formation-testing tool fails, costly rig time is lost and, as a result, some operators now run a caliper survey prior to attempting a formation test in fields where the percentage of failures in the past has been high.

TABLE 1—FORMATION TEST EXPERIENCE OVER A 3-YEAR PERIOD

Year—	Total No. of tests attempted	No. of tests attempted in percentage of No. attempted in 1944	Total No. of unsuccessful tests attributed to packer failure	Per cent of total tests attempted attributed to packer failure
1944	74	100	21	28.4
1945	142	192	19	13.4
1946	194	262	31	16.0

TABLE 2—CAUSES OF FORMATION TEST FAILURES IN 1946

Total No. tests attempted	194
Total No. unsuccessful tests	44
Per cent of total	22.7
Total No. unsuccessful tests attributed to packer failure	31
Per cent of total tests attempted attributed to packer failure	16.0
Total No. unsuccessful tests attributed to tool failure	13
Per cent of total tests attempted attributed to tool failure	6.7

TABLE 3—FORMATION PACKER FAILURES BY FORMATIONS

Formation—	No. tests	No. failures	% of total	Avg. packer depth, ft.
Ellenburger	71	11	15.5	9,370
Devonian	45	8	17.8	10,548
Permian	47	4	8.5	6,011
Simpson	9	2	22.2	8,150
Strawn	7	1	14.3	10,422
Mississippian	4	1	25.0	7,575
Silurian	3	0	...	.....
Fusselman	2	1	50.0	7,958
Pennsylvanian	1	0	...	.....
"Casing"	5	3	60.0	10,712
Total	194	31		

The cost of running a conventional electric-caliper survey is appreciable as the survey requires from 2 to 3 hours additional rig time as well as the service charge, which ranges upward with increasing depths. In order to encourage the use of caliper surveys prior to drill-stem tests, one testing company has developed a simplified mechanical caliper capable of surveying a maximum of 400 ft. per trip in the hole. Although the mechanical tool requires approximately the same rig time to run, the service charge for this tool is approximately one-third that of the electrical caliper.

At the conclusion of a formation test, there is the added problem of unseating the packers and removing the tool from the hole. Difficulties encountered in solving this problem have been materially reduced by recent improvements which permit the equalizing valve to be opened by less upward force. This feature lessens the tendency of the packer element to tear loose at the top and stick since, even on deep tests, the valve is normally opened and the pressures are equalized by the application of force substantially less than the tensile strength of the packer element.

3. Problems apparently solvable by packers if improved equipment were available.

In this category equipment is needed to allow the operator to isolate a single formation when two or more formations, separated by impermeable layers are exposed in the open hole below the casing seat of a well. Some of the cases where such isolation is desirable are listed below.

a. Formation testing of individual zones within a pay section to ascertain fluid content.

b. Selective acidization of an individual zone.

c. Squeeze cementing of an individual zone.

It is possible, although not practical, to isolate a single zone of a producing formation by the use of two anchor-type formation packers. The disadvantages of such an arrangement are so numerous and well recognized that the operations listed above are almost invariably accomplished by other means. The alternative methods normally used include gravel packing with a plastic seal, cement plugs, and cemented liners which are gun perforated opposite the formation in question. Since all alternative methods now used are expensive and time consuming, the development of suitable packer equipment to perform this operation would certainly be welcomed by the industry. This tool should be designed to be released, moved, and reset without being removed from the hole.

Actual field experiments have been conducted with a packer which, if successfully developed, could fulfill this need. In the West Texas area,

failures of field tests conducted to date with this new tool have been the result of mechanical difficulties and it is possible that improvements in design will eliminate these troubles.

Figs. 1 and 2 illustrate one possible use of this tool. Fig. 1 shows this tool in running position and Fig. 2 shows the tool set in position to isolate a single formation from two adjacent formations exposed in the open hole below the casing seat of a well.

The packing elements of this tool are expanded and sealed by hydraulic pressure applied to their interior surface, whereas the packers of tools discussed earlier in this paper are sealed by mechanical compression of the packing element. If successfully developed, the hydraulically inflated packer would offer the following advantages:

1. Greater expansion of packing elements.
2. Closer conformation to wall contours since packing element has very low internal resistance to flow.
3. Operational flexibility permitted by ability to release, move, and reset tool without removal from the hole.
4. Better seal under pressure since internal pressure in packer element increases with increase of pressure differential across the packer element.

4. Recommended practice for running, setting, and removing packers.

a. Selection and checking of equipment.—The practice recommended for casing packers under this heading is also applicable to formation packers. In the case of anchor-type formation-testing tools, the practice of using drill collars as an anchor is recommended, particularly on deep tests, in order safely to withstand the column loading imposed by the weight of the drilling fluid in the annulus. Also, the use of several drill collars or a centralizer above the tool is recommended in order to prevent "cocking" of the tool in the hole when the setting load is applied.

Hole-diameter information, when available from caliper surveys, should be made the basis for the selection of the maximum diameter tool possible to be safely run in the hole.

b. Mechanical condition of the well.—It is essential that every effort be made to clean the hole prior to running open-hole packers, particularly those of the anchor type. In drilling wells, the well should be circulated at maximum pump capacity until cuttings no longer come up with the mud returns. Also, the wall cake should be maintained as thin as possible by conditioning until a low water loss mud is obtained.

Where anchor packers are to be run, especially for formation testing, accurate measurements of the depth of the hole are essential. The possibility of mistaking for true bottom an anchor contact with bottom hole accumulations is eliminated when the hole depth is accurately known. Accurate records of drilling time facilitate selection of proper packer points. For deep tests, caliper surveys should be considered in order to obtain hole information prior to the test.

c. Running packers.—The practice recommended for casing packers under this heading is also applicable to formation packers. When running anchors, particularly with formation testing tools, every effort should be made to work the anchor pipe to the actual hole bottom before an attempt is made to set the packer and open the tool. This practice will minimize the possibility of packer slippage and failure sometimes caused when the anchor pipe seat on bottom hole accumulations is washed out at the time the tool is opened.

d. Setting packers.—The practice recommended for casing packers under this heading is also applicable to formation packers. On drill-stem tests, every precaution should be taken to set and seal the packer before an attempt is made to open the tool. When the packer is collapsed and the tool opened in one continuous operation, there is a possibility of washing out the hole wall around the packer which often causes the packer to fail to obtain a seal.

With the old model of one tool available for this service, it is possible only to set the packer and open the tool simultaneously. The design of this tool has been modified to permit these operations to occur separately and several of these modified tools are in service in West Texas at this time.

e. Removing packers.—Formation packers are generally difficult to unseat, particularly after remaining in the hole for long periods of time. As discussed under this heading for casing packers, removal is facilitated by the use of packers provided with an equalizing valve. To facilitate removal in difficult cases, positive pressures are sometimes applied below the packer although this practice is undesirable after drill-stem tests since it ruins the test.

Successful removal of difficult cases of stuck open-hole packers is rarely accomplished by following a routine procedure. As in the case of stuck casing packers, the circumstances attending the individual job govern the methods applied.

Once seated, the packer should be pulled from the hole slowly to lessen the tendency to swab. This is particularly true after formation tests as swabbing caused by rapid tool removal can result in loss of control of the well.

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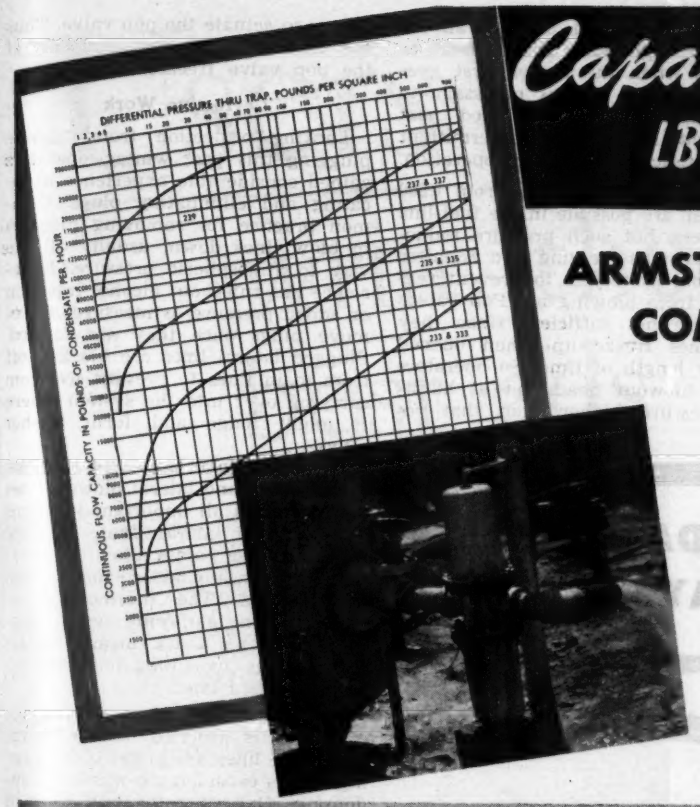
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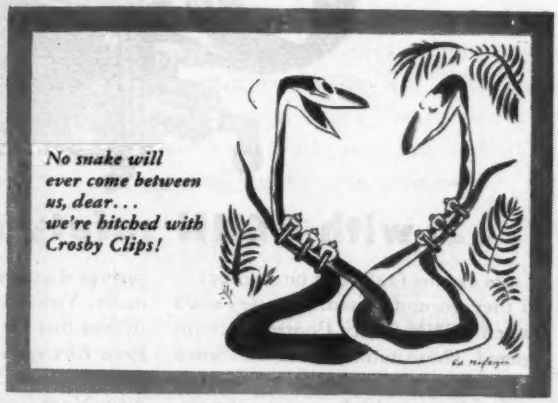

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Carthage Engineers Fight Hydrates

(Continued from page 60)

sure. The method for obtaining dry fuel gas is shown graphically in Fig. 5 and Figs. 6 and 7 illustrate field installations. The outgoing gas line from the heater is tapped for fuel gas, and condensate and water are knocked out and returned to the line in a pot fabricated from 8-in. pipe stock. The dry gas from the top of the pot is then passed through the stack base, then through the water bath of the heater. The pass through the stack base, not used in all installations, provides instant heat to the gas when the heater first goes on. The water pass is necessary to give the fuel gas continued heat while the heater is on intermittent thermostatically controlled operation.

One-stage pressure cuts from 1,200 to 25 psi. are possible in the fuel-line regulators, but such pressure reduction threatens freezing and requires additional protection to prevent regulators from blowing up. Pop valves alone are not sufficient since they sometimes freeze up when opened for any length of time. So operators install blowout heads set at bursting pressure higher than that required to actuate the pop valve. Thus the blowout head goes out only if the pop valve freezes.

Corrective Work

Lacking protection from hydrate plugging this past winter, operators gained considerable experience in locating and eliminating plugs. Common practice for removing plugs is to blow lines down, usually all the way to atmospheric pressure. Experience has ruled out alcohol injection or added pressure as measures to remove plugs once they are formed. Plugged lateral lines are blocked off from main lines to prevent ice from carrying over into the system where it might lodge and form further plugs.

In the larger loop-type systems, block valves and lateral blowoff lines are located at all important junctions of main and lateral lines. Pressure gages at these points allow operators quickly to locate line sections which are plugged. The thermostats installed in one gathering system provide the same quick means for locating plugs, by noting temperatures along plugged lines.

When the plugged section is located, it is isolated blown down. When the lines are large, such blowing causes considerable waste of condensate. One operator has resorted to installing a separator on the blowdown line, and recovering and trucking condensate to the plant. The same operator is considering the use of a trailer-mounted horizontal separator which can be connected to blocked lines with a length of high-pressure drilling hose. This will not only save condensate but reduce the hazard of blowing it to the atmosphere. The practice has disadvantages, however, since many parts of the field, particularly in the Sabine River bottoms, are inaccessible to heavy vehicles, and blowing down through a separator must be done slowly to prevent liquid from being carried over with gas.

In repressuring sections after they have been blown down, most operators load the section entirely from the well end, thereby using warmer gas. Sections near wells or behind heaters may be loaded fast with good success.

In the more compact, radial-type gathering systems, plug location and elimination is relatively simple. Plugging of a line is readily evident at the plant. Since such lines are generally small, they are blown down completely without being blocked off in sections. Shutting down one of several feed lines to a plant does not greatly interrupt plant operations.

Millard K. Neptune, assistant manager of Phillips Venezuelan Oil Co., is in the United States from Caracas on a 6-week business trip.

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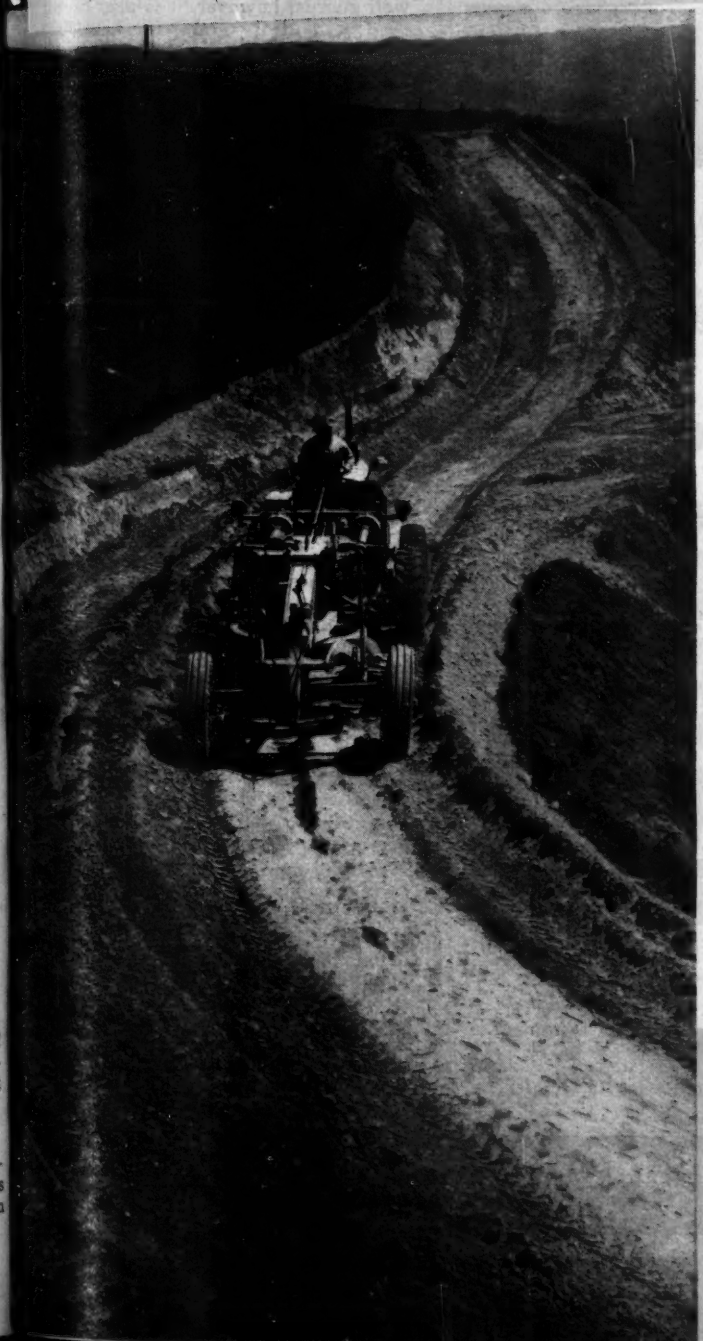

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Recent Innovations in Lease Work Barges

(Continued from page 61)

operation. Self-contained propelling units were installed on the work barges. The barges used in connection with work on pipe lines and well guards were also equipped with propelling units. In addition to this the latter-type barges were equipped with a specially designed winch and boom.

Murray-Trigurtha propelling units, purchased by Gulf from the Government at a unit price of approximately $800, have now been installed on all work barges in the delta area. These units are powered by a 40-hp. engine equipped with a 4 to 1 reduction gear. Adaptation to the barges was accomplished by welding two short sections of channel iron to the barge to serve as a base for bolting the engine.

The use of this particular type of propelling unit on work barges offers several advantages when compared with tug-boat operation. Its installation is relatively simple and inexpensive. Under the old method of work-barge operation, the cost of each tug boat employed amounted to approximately $20 per day, plus the cost of tow rope, fuel, and lubricating oil. Due to the low initial cost of the propelling units and the saving effected through such installations, payout is accomplished after a very short period of operation.

The spotting of work barges on location in rough water was rather difficult, at times, under tug-boat operation. The propelling units resemble outboard motors in principle and afford the same high degree of maneuverability. The controls are located in the front portion of the barge house and the direction of the propelling wheel is automatically indicated by an arrow on the control box in front of the steering wheel. As in the case of the outboard motor, the wheel on these units can be cranked up out of the water when the shear pin requires replacement.

The winch and boom shown in Fig. 4 was designed primarily for setting well guards; however, it is also being used as a utility crane for handling heavy items of equipment. It can be adjusted to any angle and extended to reach approximately 35 ft. from the base.

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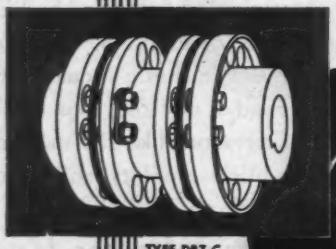

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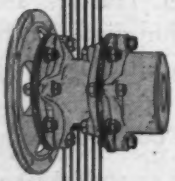

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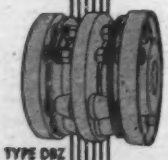

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Hard-Rock Drilling in The Permian Basin

(Continued from page 64)

pumps that are predominant in the area are rapidly approaching uneconomic weights, so it would seem that increased pump horsepower, if required, must be gained by a change in basic pump design. One type which will give less weight per horsepower is the multicylinder plunger pump. Although the first experimental models tested have not been completely successful, design changes to give satisfactory operation may be made. An estimate has been made that one type of 1,000-hp. plunger pump can be built weighing about 26,000 lb. At present the larger power pumps are approximately 600 hp. and weigh over 40,000 lb.

A need is now being felt for more and better instrumentation on drilling rigs. Some of these are: improved weight indicators, tachometers, drilling-rate recorders and instruments for obtaining maximum efficiency from boilers and engines.

Drilling equipment — Subsurface.— Developments in rock bits during the past year have not been striking. Laboratory research and field testing are being carried on constantly by bit manufacturers, and improvements in steel and bearings are being made from time to time to increase rotating life. If the rotating life of the bits used in the Winkler County well mentioned could be increased from 7 to 14 hours at the same average drilling rate, total bits could be reduced to about 37. If only 37 bits had been used in the 8,065 ft., there would have been 36 fewer round trips. Assuming 4 hours per round trip, the

total time saved would be 6 days. It is not the cost of the bits that is most important. If the long-life bits each cost over twice as much as the present bits, a net saving would result because of the reduced round trips with consequent reduced wear on equipment.

Full-hole diamond-bit drilling has been attempted in West Texas several times in the past few years with little success, but diamond coring has been successful in the Permian formations during recent months. Coring in older formations below the Permian has been limited, but the effectiveness of diamond bits for this work should be attempted in the near future.

Much work has been done by manufacturers and by drilling organizations to extend the life of drill pipe and drill collars in West Texas. Experiments with corrosion inhibitors such as sodium chromate to reduce corrosion fatigue of drill pipe have been carried on. Results are promising but perhaps some of the reduction in corrosion fatigue failures during 1946 has come from keeping drill pipe in tension with long drill collar strings and slower rotating speed. Internal plastic coatings for drill pipe are being developed and seem to have some merit.[3]

The use of long drill-collar strings to run high bit weights has indicated a need for work on joints, surface hardening, and work hardening of threads to provide maximum drill-collar life with a minimum of failures. A fishing job for a long drill-collar string is expensive. Reduction of this hazard by research work, field inspection, and frequent shop work on collars can be justified economically. Development of an inside cutting tool for lost collars should be possible and is desirable.

Future Drilling Practices

Many of today's experiments may be accepted drilling practices in the future. One of the most promising is reverse-circulation drilling. Originally, this was initiated in an attempt to recover samples large enough to obtain as much reservoir information as possible without coring. Many operators believe that porosity and permeability measurements from large samples are as valuable as information gained from cores. Except for the delay caused by handling the circulating head, rotating time has been approximately the same for normal and reverse circulation.

Bit performance with reverse circulation has been surprising. On two offset wells in Gaines County, normal circulation was used on one and reverse circulation on the second from the intermediate casing seat at 4,200 ft. to the total depth of 7,700 ft. Rotating time on the two wells was the same, but the well using reverse circulation required 23 fewer bits or a 30 per cent reduction in the number of bits. Presumably this was because regrinding of cuttings was eliminated. Reverse circulation is not practical at all times because of lost returns. When practical, it may be used to obtain samples 8 to 10 times as large as can be recovered with conventional circulation.

There is some evidence that the drill-pipe diameter and hole diameter may affect drilling rates. For example, when drilling a 9⅞-in. hole, 5⅛-in. drill pipe is frequently used instead of 4½-in. Using the larger pipe, faster drilling time and improved bit performance have been reported with the same weight on the bit. With 3½-in. drill pipe, a 6¾-in. hole can usually be drilled faster than a 7⅞-in. hole if the same weight per inch of bit is applied. A 7¾-in. hole may be drilled faster than an 8¾-in. hole using 4½ in. drill pipe.

Data on this and on the most economical hole size are not conclusive but are of sufficient interest to justify additional study and experimenting.

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1. Annual Review, The Oil and Gas Journal, Volume 45, No. 38, p. 191.
2. Yearbook Forecast, The Oil Weekly, Volume 124, No. 11, p. 129.
3. L. E. Trishan, Plastic Coating Inside Surface of Drill Pipe, Petroleum Engineer, Volume 18, No. 2, p. 194.

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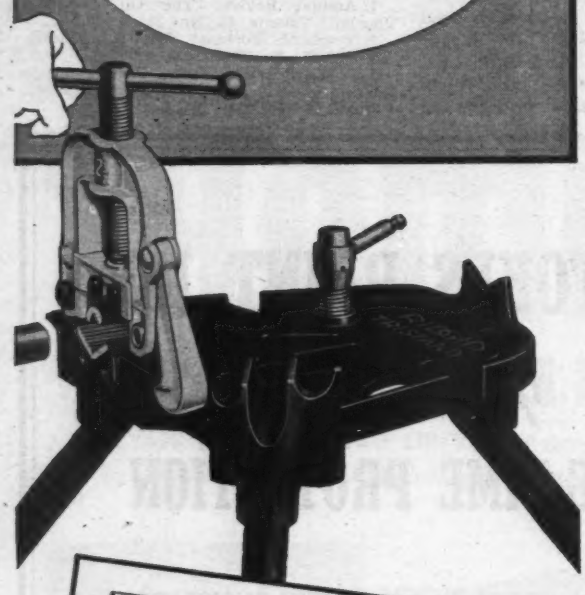

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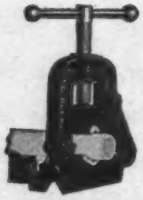

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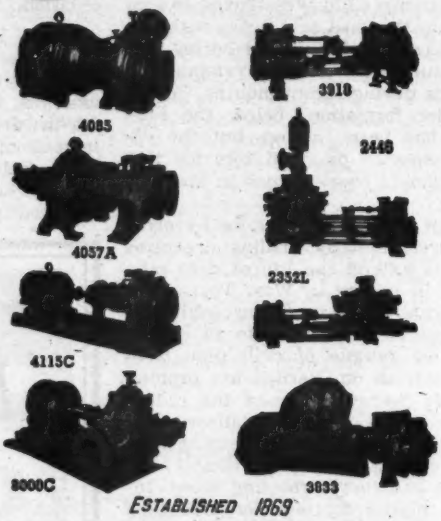

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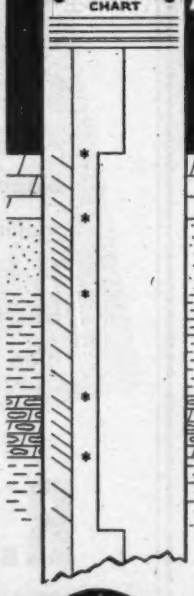

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MODERN Rotary DRILLING

Effect of Engine Characteristics

LOAD changes and engine characteristics affect the problems of design and selection of the hoisting system of a rotary rig. With load cycle changes already discussed (Installment 13) the engine and transmission characteristics are considered here.

Engine Characteristics

The torque developed by a steam engine increases as the speed decreases, reaching its maximum at the point of stalling. The internal-combustion engine develops its maximum torque at, or near, its rated speed. As the speed decreases the torque decreases also.

The steam engine has a wide range of speed variation. An internal-combustion engine utilizes only a portion of its capacity during certain portions of the hoisting cycle, with speed of the engine held constant by the governor.

The above characteristics make the steam engine ideally suited for the requirements of the hoisting cycle of a rotary rig. On the other hand an internal-combustion engine is basically unsuited for such operations. Many advantages, however, which the power rig has in comparison with a steam rig, such as economy of operation, portability, etc., furnished the stimulus needed for development of means needed for compensation of the unfavorable characteristics of internal-combustion engines. As a result of this development a modern power rig is, under certain conditions, capable of competing favorably with steam rigs at all drilling depths. The development of a modern power rig, which started about 17 years ago, has gained particular momentum during the last few years.

Mechanical Transmission

In original applications of a power rig an internal-combustion engine was used simply in conjunction with ordinary steam-rig draw works and with reverse clutch between the engine and the draw works. This arrangement was not satisfactory for several quite apparent reasons.

Need for more than three or four speeds of steam-rig draw works may be illustrated by example shown in Fig. 15. The power chart is for six-speed draw works, powered with internal-combustion engines capable of developing 340 hp. when loaded to capacity.[1] With long string of pipe pulled, the trip is started with the lowest drum speed. As each stand of the pipe is removed the load is lightened but, with governor holding the engine to constant speed, the hoisting speed remains the same until the load is lightened sufficiently to permit shifting into the next gear.

With the speed constant and the load decreasing, the power delivery of the engine decreases within each gear. It is apparent that the smaller the number of available speeds, the larger will be the drop of the power actually used in each drum speed, in relation to the engine's capacity.

Another apparent need for a change was in the types of clutches used. Development along these lines, and other improvements and changes resulted in modern, mechanical-transmission, power-rig draw works, substantially different from those used in the past in conjunction with steam rigs.

Other Transmissions

Paralleling the evolution of the mechanical transmission of power from the internal-combustion engine to the draw works, was development of electrical and hydraulic means of accomplishing this purpose. Both of these methods of power transmission are capable of reconciling the conflicting speed-torque characteristics of the driving and the driven components of the rig. This results in flexibility approaching, or equaling, that of a steam rig.

The electric rig has been brought to a high degree of mechanical perfection. Its acceptance has been rather slow, because of the high initial cost of the equipment and because of need for specialized maintenance.

Use of hydraulic power transmission with a rotary rig is a comparatively new development. Its widening application, commensurate with the degree of success attained so far, may be expected.

Discussion of recent improvements in draw works, transmissions, and related equipment will be the subject of several of the following installments of the series.

Reference

1. Chart from: T. P. Sanders: Torque Converters Applied to Drilling and Servicing Rigs—The Oil and Gas Journal, July 2, 1942, p. 25.

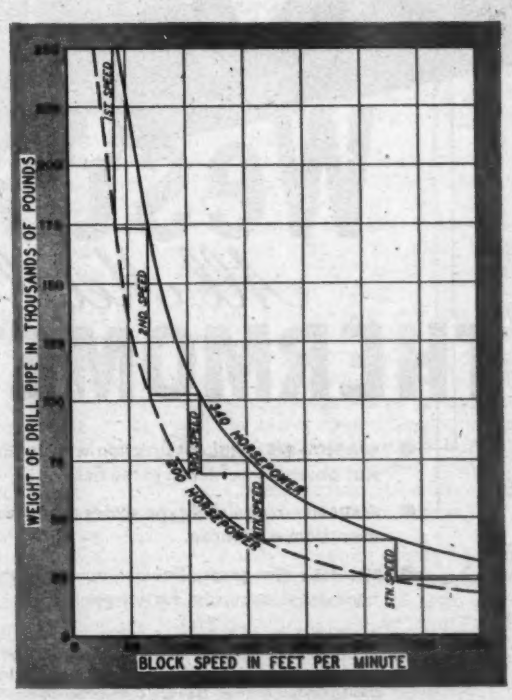
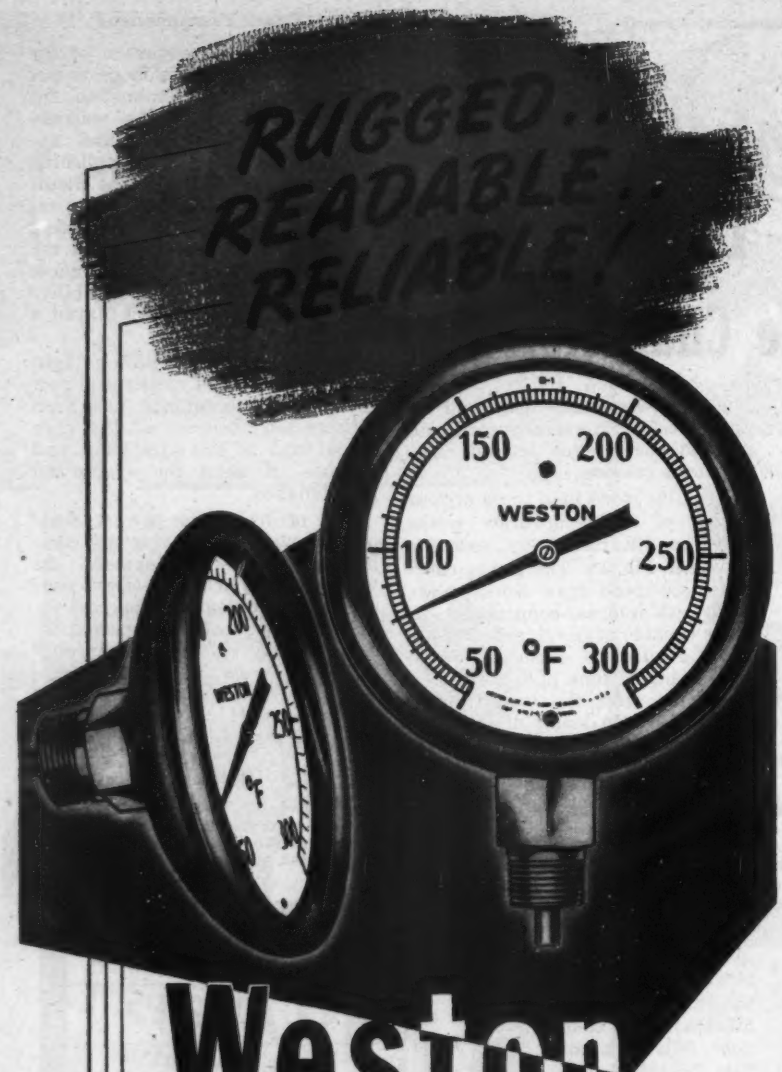


Fig. 15—Power chart for an internal-combustion-engine-powered rig

No. 14 in a series by Joseph Zaba, petroleum engineer, Houston



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Composition of Mud Acid and Its Function in Sand Horizons

REGULAR mud acids are composed of 15 per cent hydrochloric acid (by weight), from 3 to 9 per cent fluorine and various types of alcohols, detergents, and emulsion breakers. In addition to the above chemicals, there are one or more inhibitors which are used to keep the acid from attacking various metals used in the acid pumping and well equipment.

Purpose of the hydrochloric acid is to keep an acid medium after the fluorine has combined with the silicates present in the muds or formation. The detergents improve the penetration of the acids by degreasing the sand formation. The emulsion breakers prevent forming emulsions from any of the strong acid, salt water, and oil, therefore preventing blocking of the void spaces in the sand. The alcohols lower the surface tension of the acid mixture to 28 to 30 dynes.

The percentage of fluorine content of these acids may vary in different applications as sand bodies can be of different structure and content. One gallon of mud acid theoretically is expected to dissolve about 1/3 lb. of clay. The low-surface-tension chemical mixture is to release any of the fresh water or mud-filtrate films that may surround the fine-grained sands. These two functions combined are important and the benefits derived from the treatment might be credited either to one or the other or a combination.

In sands of the Gulf Coast series there may be one or more of the different types of sealing clays in the sand body. The fresh water coming in contact with these clays tends to cause them to swell, resulting in what commonly is known as a water block. The muds can help keep out but may not retard all of the water from filtering into the sand and carrying with it small particles of mud. Any such action will result in tighter cementation or blocking of the void spaces. Mud acids used in such cases are very beneficial to the operator in that the majority of filtrates and water blocks caused by the sealing of the clays are removed, leaving the formation in practically its original state. This may allow the well to flow and produce most efficiently and ultimately yield to the operator a larger recovery of oil.

Mud acidization is relatively new in the oil industry and even today many will acknowledge their limited experience concerning this phase. Many of course have had experience in pumping hydrochloric acid into wells for various purposes but have had very little experience in methods to be employed and the preparation for such treatment where sand formations are concerned. Therefore it is always wise to consult an engineer acquainted with the methods before attempting such a project.

Some operators have used mud acids and condemned their use because of the results. Negative results sometimes can be traced back to initial analyses and to not satisfactorily completing the treatment. Experienced personnel in this field have been up against many problems and various phases of acidizing technique and it is these whom operators should consult before undertaking specialized mud acidization completions.

The operator should not consider mud acidizing inexpensive. In many cases considerable work and time are involved. Comparing the expense of an acidizing treatment with that of a complete mechanical treatment, however, the acid treatment sometimes can be a great deal cheaper, less hazardous, and more effective.

Mud acidizing, if used correctly, can perform such operations as:

1. Increasing the well-drainage area:

a—By cleaning void spaces between sand grains.

b—By removing water-block conditions set up by invasion of fresh water during drilling and workover operations.

c—By removing muds which have filtered into the sand body, causing cementation of void spaces.

d—By restoring sand conditions to as near the original state as possible before the invasion of water and muds during drilling.

e—By increasing gas-well potentials and recovery.

f—By increasing gas or water intake of injection wells at lower pressures.

g—By reopening contaminated void spaces which have been blocked off by the use of muds, fresh water, and mud-contaminated cement forced into the sand body during cementing or squeezing operations.

2. By cleaning liners or perforations and opening void spaces:

a—By dissolving deposits of calcium carbonates on liners, or perforations, so frequently found in pumping wells where water is being produced.

b—By the removal of heavy mud sheaths left in wells from drilling operations, which cut off or retard production when the bottom-hole pressure is not sufficient to force fluids to producing point.

3. Increasing flowing or pumping life of wells.

4. Cleaning sand void spaces of muds and water block before squeezing operations, thereby allowing cement to travel to the most permeable part of the sand body, and which likely is the portion producing salt water.

5. In preparation for squeeze jobs, the producing horizons may be opened up (broken down) without the application of unduly high pump pressures at the surface, and the lower pressures also thereby remove the hazard of bursting the tubing or conductor string.

6. Cleaning formation face and pipe before cementing liners.

7. Setting of pipe:

a—By cleaning walls of hole between two sands, allowing a permanent separation of two sand bodies, which may be less expensive than underreaming top sand for cement blocking.

b—By cleaning walls of hole in formation when a large gas cap is overlying the oil-producing portion of a sand reservoir.

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Top photograph shows the molding of a large Chevron ring. Photo at left shows a few of the thousands of molds of various sizes. Below is photo of Chevron packing which shows unique hinge-like construction.

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GARLOCK *Chevron* PACKING

REFINING

Work Begins on Shell's 35,000-Bbl. Flashing Unit

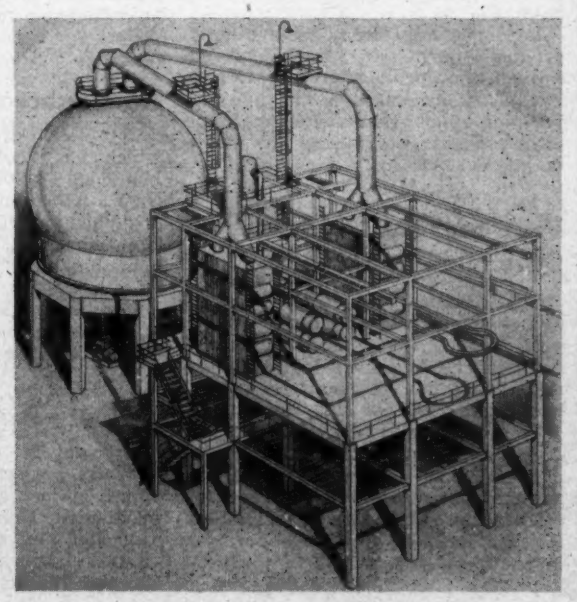
CONSTRUCTION has started on a new vacuum flashing unit at the Wood River, Ill., refinery of Shell Oil Co., Inc., according to H. D. Dale, refinery manager. The new unit, the first major construction undertaken at the plant since the war, will supply additional feed stock for the refinery's twin catalytic cracking plants.

The vacuum flasher will process 35,000 bbl. of topped crude daily. The flasher will separate the topped crude into light and heavy fractions.

The spherical flash tower, a new design for this type of equipment, will have an inside diameter of 30 ft. Heat exchangers will contain approximately 50 miles of tubes. In addition, 1½ miles of 6-in. tubes will be built into two vaporizing type furnaces. A transfer line, carrying oil from the furnaces to the flash tower, will have an inside diameter of 4 ft., and a mixture of vapor and liquid will flow through it at a velocity of 280 ft. per second.

Operating at 770° F. and 1.16 psia., the new unit will flash 80 per cent of the topped crude overhead. Extensive heat economy will be achieved by the use of heat exchange between the products and the crude feed, with over half of the entire heat transfer to the oil being accomplished in the unit. After passing through the heat exchangers, the feed will flow through the furnaces and then through the transfer line to the bottom of the flash vessel. Here it will enter a cyclone-type separator which will separate the vapor and liquid. All lines and vessels, which will be exposed to oil temperatures of 500° F. or more, will be made of corrosion - resistant chrome - molybdenum alloys.

The plant is expected to be in operation during the latter part of the year. C. F. Braun Co., Alhambra, Calif., holds the contract for engineering and construction.



Engineering sketch of the new vacuum flashing unit under construction at Shell's Wood River, Ill., refinery

Petroleum Division A.C.S. To Hear 25 Papers

ADVANCES in petroleum research which may open a new field of organic chemistry, based on high-boiling compounds of great commercial utility, will be reported to the Petroleum Division of the American Chemical Society April 15-17 during the society's 111th national meeting in Atlantic City, N. J., according to Dr. Gustav Egloff, chairman of the division and research director of the Universal Oil Products Co.

New chemical tools and techniques for producing pure high-boiling aromatic hydrocarbons and new applications of older methods will be among the subjects of 25 papers to be presented by chemists from the laboratories of the oil industry, the Government and the nation's technical schools.

The use of ultraviolet spectrophotometry in studying high-boiling hydrocarbons will be explained by Alden P. Cleaves and Mildred E. Carver, of the N.A.C.A. Aircraft Engine

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Research Co. Alfred E. Hirschler and Sonta Amon, of the Sun Oil Co., Norwood, Pa., will report on adsorption as a new tool in the preparation of high-purity hydrocarbons. Progress in the evaluation of lubricating oils by means of spectrophotometry will be described in a paper by G. L. Clark and K. J. Pipenberg, of the University of Illinois, and T. W. Culmer of Ohio Oil Co., Robinson, Ill.

"The Mass Spectrometer in Organic-Chemical Analysis" will be presented by R. C. Taylor, R. A. Brown, W. S. Young, and C. E. Headington, of Atlantic Refining Co., Philadelphia. Production of better diesel fuels by hydrogenation will be discussed by J. A. Tilton, W. M. Smith, and W. G. Hockberger of the Esso Laboratories of the Standard Oil Co. of New Jersey, Louisiana Division, Baton Rouge. A method of making toluene by conversion of xylene will be reported by P. L. Brandt, R. J. Lee, H. D. Radford, L. H. Klemm, and P. S. Drennan of Pan American Refining Corp., Texas City, Tex.

Recent developments in the study of petroleum and its products which has been under way for several years at the National Bureau of Standards in Washington, will be described in four papers by Dr. Frederick D. Rossini, chief of the bureau's section on thermochemistry and hydrocarbons, and seven colleagues.

Others to be heard are: Henry J. Hibshman of the Esso Laboratories, Standard Oil Development Co., Elizabeth, N. J.; M. R. Cines, N. D. McAllister, and L. R. Fruit, Phillips Petroleum Co., Phillips, Tex.; R. T. Sanderson, Beacon Research Laboratory, The Texas Co., Beacon, N. Y.; G. U. Dinneen, C. W. Bailey, J. R. Smith, and John S. Ball, Petroleum and Oil-Shale Experiment Station, Laramie, Wyo.; M. R. Lipkin, W. A. Hoffecker, C. C. Martin, and R. E. Ledley, Sun Oil Co., Norwood, Pa.; F. W. Melpolder, F. G. Ciapetta, S. J. Macuga, and L. N. Leum, Atlantic Refining Co., Philadelphia; Vladimir Haensel, V. N. Ipatieff, Louis Schmerling, R. B. Thompson, and J. A. Chanicek, Universal Oil Products Co., Riverside, Ill.; B. L. Evering, E. L. d'Ouville A. P. Lien, and R. C. Waugh, Standard Oil Co. (Ind.), Whiting; H. E. Rasmussen and P. P. Mellio, Socony-Vacuum laboratories, Paulsboro, N. J.; Herman E. Ries, Jr., Marvin F. L. Johnson, and John S. Melik, Sinclair Refining Co., East Chicago, Ind.; P. G. Nahin and H. C. Huffman, Union Oil Co. of California, Wilmington, and V. I. Komarewsky, L. B. Bos, and J. R. Coley, Illinois Institute of Technology.

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Improved Rubber Is Announced by Phillips

Development of a greatly improved butadiene - styrene synthetic rubber which "appears to be equivalent to natural rubber in many important properties," was announced this week by Frank Phillips, chairman, and K. S. Adams, president, of Phillips Petroleum Co.

Improvements in the synthetic product, they said, was achieved through the development of extremely rapid emulsion polymerization recipes for rubber-manufacturing processes carried out at very low temperatures.

Four Technical Sessions Scheduled at St. Louis

Four technical sessions and an open dinner meeting will feature the mid-year meeting of the Division of Refining of the American Petroleum Institute at the Jefferson Hotel, St. Louis, June 2-3.

The morning session on Monday, June 2, will be devoted to activities of the divisional committees and the advisory committees on fundamental research projects. Albert E. Miller, Sinclair Refining Co., New York, is in charge of preparation of the program.

Monday afternoon's program will be on the design, construction, inspection, and repair of refinery equipment, with preparation of the program under the direction of Walter Samans, Sun Oil Co., Philadelphia.

The dinner session will include speakers of general interest to all refiners. Dr. J. Bennett Hill, Sun Oil Co., Marcus Hook, is developing this program. Reservations must be made well in advance of the meeting for this dinner, according to an A.P.I. announcement.

Tuesday's two sessions, both morning and afternoon, will be devoted entirely to gasoline and its relationship to other refinery products. W. M. Holaday, Socony - Vacuum Oil Co., New York, is working up the program. The general committee of the division will meet at noon Tuesday.

Pan American Establishes Chemicals Department

Pan American Petroleum & Transport Co. has established a chemicals department of the Pan American Refining Corp. which will be under the direction of F. J. Smith as manager, with headquarters in the company's New York office.

Smith and his assistant, J. F. Scott, are being transferred to the New York office from the Texas City refinery, and W. T. Herget has been appointed a department head in the Texas City refinery and will be responsible for chemical-manufacturing activities, it was announced.

The new department will be responsible for the manufacture and sale of petroleum chemicals which are being developed through a research program carried on in the Texas City research laboratory. These products include aromatic solvents, plasticizers, resins, polymers, and miscellaneous unsaturated intermediates.

New Laboratory Finished

Completion of an expansion project which has doubled the size of its Mobilheat laboratory in Brooklyn, N. Y., has been announced by Socony-Vacuum Oil Co., Inc. The new laboratory unit contains all types of home-heating equipment. These will be studied by research experts to determine maximum efficiencies. Operating experiments with new types of fuel oil also will be made.

Refinery Project Approved

A catalytic - cracking - plant construction project to cost $16,000 was approved last week by the Civilian Production Administration for Sinclair Refining Co. The project will be undertaken at the company's East Chicago, Ind., refinery.

NATURAL GAS

United Asks Approval For New Program

WASHINGTON.—United Gas Pipe Line Co., Shreveport, has filed an application with the Federal Power Commission requesting permission to construct about 93 miles of 18-in. pipe line from Baxterville gas field in Marion County, Mississippi, to a connection with the company's line near Mobile, Ala.

Permission also was asked to replace about 8½ miles of 12-in. pipe on the Mobile-Pensacola main line with 16-in. pipe and to loop a 6-in. tap line extending from the Mobile-Pensacola line to the Florida Pulp & Paper Co. near Cantonment, Fla., with about 3½ miles of 8-in. pipe. Cost of the facilities has been estimated at $3,150,000.

On July 2, 1946, FPC authorized United Gas Pipe Line to construct about 10 miles of 12¾-in. line west from Baxterville field to the company's main transmission line. The company has indicated that since issuance of the certificate, gas requirements have risen rapidly. Such requirements cannot be met without looping a large portion of the lines now serving the area, United said, and it believes it highly desirable and also better operating practice to substitute the longer line for the short connection.

Total gas reserves in Baxterville field are estimated at approximately 250 billion cubic feet, and a contract with Gulf Refining Co. assures coverage of 150 billion cubic feet, the company stated.

The company estimated the 18-in. line from Baxterville field will have a maximum capacity of approximately 77,000,000 cu. ft. per day. The new 16-in. loop line will increase the capacity of the Mobile-Pensacola line from 26,000,000 cu. ft. per day to approximately 49,000,000 cu. ft. per day.

FPC Reports Show Gas-Revenue Gain

WASHINGTON.—Operating revenues of natural-gas companies reporting to the Federal Power Commission amounted to $575,392,481 in 1946, an increase of 4.8 per cent over the $549,214,706 received in 1945.

Gas operating-revenue deductions increased 5 per cent to $466,172,530. Of this amount, operating expenses accounted for $343,395,771, up 9.8 per cent; depreciation accruals for $54,682,993, down 1.8 per cent; and tax accruals for $68,093,766, down 9.8 per cent.

Natural-gas-utility operating income in 1946 amounted to $109,338,408, 3.6 per cent more than the $105,518,872 reported in 1945.

Gross income, including gas utility, other utility, and nonoperating income amounted to $152,184,636, an increase of 6 per cent over the previous year. Net income for the period was $118,999,809, up 16.9 per cent from the 1945 net of $101,832,284.

Revenues from residential and commercial service increased 6.2 per cent and 5.5 per cent, respectively, over 1945. Revenues from industrial service were up 1.9 per cent. In the last quarter of the year industrial revenues were up 10.7 per cent over the like period in 1945. There were increases of 6.1 per cent, 3.5 per cent, and 2.3 per cent, respectively, in residential, commercial, and industrial gas-consumer sales. Last-quarter industrial sales were up 12.7 per cent over the comparable quarter in 1945.

Book cost of gas plant of the reporting companies aggregated $1,975,171,222 on December 31, 1946, compared to $1,900,368,600 on the same date in 1945.

The data was based on monthly statements filed with the commission by 85 natural-gas companies.

Annual Convention of S.G.A. To Open April 16

An attendance in excess of 800 is expected for the annual convention of the Southern Gas Association, to be held in Biloxi, Miss., April 16-18, according to Dean A. Strickland, S.G.A. president.

The meeting will be the first annual convention for the S.G.A. as a permanent organization.

Program for April 16, preceding the formal opening of the convention, will be devoted to special meetings, including a Southwest Personnel Conference, accident-prevention round table, and sales conferences. Sectional programs have been scheduled for the afternoons of the last 2 days.

Merger Hearing Postponed

WASHINGTON.—The Federal Power Commission postponed the hearing set for April 1, on the application filed by Memphis Natural Gas Co. for authority to acquire all of the gas assets of Kentucky Natural Gas Corp. and for Kentucky to sell such assets. The commission did not immediately reschedule the hearing.

Postponement was made at the request of Memphis Natural who stated that it would not be in a position to proceed with the hearing due to the fact that a revised plan for the consolidation of Kentucky Natural and Memphis Natural would be filed on or before April 17.

A.G.A. Shifts 1947 Convention to Cleveland

The executive board of the American Gas Association has announced that the twenty-ninth annual convention of the association will be held October 6-8 in Cleveland, Ohio.

The 1946 convention last fall voted for San Francisco as the next convention city. All indications point to a large attendance at the 1947 convention which under present circumstances would tax the hotel facilities in San Francisco and result in insufficient hotel reservations to accommodate the members of the association, an A.G.A. announcement said. The executive board of the A.G.A., meeting in Boston March 21, decided it advisable to postpone the San Francisco meeting and voted to hold the 1947 convention in Cleveland. Announcements covering hotel reservations and other details will be mailed to members of the association in the near future.

Rate Argument Set

WASHINGTON.—The Federal Power Commission has set April 9 for oral argument before the commission in Washington in proceedings involving an investigation of Pittsburgh & West Virginia Gas Co. and Kentucky West Virginia Gas Co. rates subject to FPC jurisdiction.

Natural Gasoline

Skelly Will Build New Natural-Gasoline Plant

A new natural-gasoline plant will be constructed soon in Stephens County, Oklahoma, by Skelly Oil Co., bringing the company's total number of gasoline plants in Kansas, New Mexico, Oklahoma, and Texas to 14.

The company also is planning to double the capacity of its large plant at Eunice, N. M. Skelly last year produced 103,886,945 gal. of natural gasoline and allied products from its 13 operating plants, according to the company's annual report.

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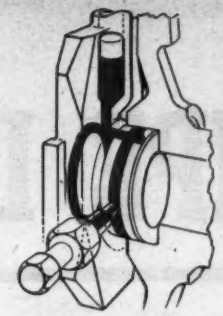
Then make up your own mind. We believe you will decide to join the ever growing list of satisfied users of McEvoy valves.



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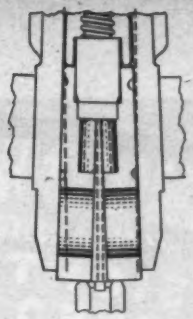
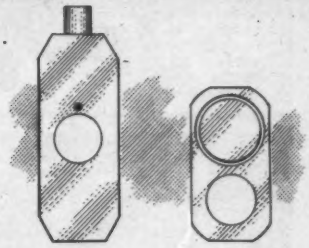
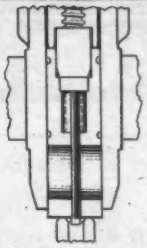
Stands guard continuously—protects your valve by injecting lubricant *automatically* to stop any leak.



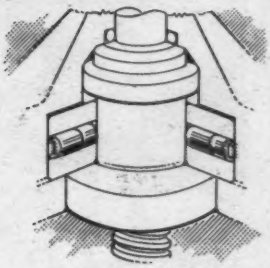
SELF ALIGNING GATES AND NON-DISTORTING SEATS
banish failures due to pressure and temperature distortion.



CHROME PLATED SEALING SURFACES
minimize friction — lengthen valve life — make operation easier.



NON-WEDGING DESIGN
eliminates "cheating" and consequent galling — makes valve easier to operate and helps prevent leaks.



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PIPE LINES

Wyco Pipe Laying To Start May 15

Wyco Pipe Line Co. has issued specifications to contractors for bids to be received April 15 for the construction of a 260-mile, 8-in. products pipe line connecting Casper refineries with Cheyenne, Wyo., and Denver, Colo.

The project has been divided into two sections. Work will start May 15 and continue for approximately 4 months. The Wyco company includes Standard Oil Co. (Ind.); The Texas Co.; and Socony-Vacuum Oil Co., Inc. Engineering and construction of the line is being handled by Stanolind Pipe Line Co.

Sinclair Working on Last Loop of 18-In.

Sinclair Refining Co., pipe-line department, has completed two loops and recently commenced a third loop of its 50-mile, 18-in. program. The three loops are located at 15 to 20-mile intervals along the main trunk line in Kansas at the following sections: Humboldt - Carlyle; Greeley-Osawatomie; and Ridel-Little Blue.

In connection with the work some 8-in. pipe is being removed from the trunk system. The job has been contracted by O. C. Whitaker Co. Although surveys have been made for 378 miles of 18-in. looping from Seminole, Okla., to Carrollton, Mo., construction plans to date only provide for laying the 50 miles of 18-in.

Work Starts on Loop For Chicago Line

Natural Gas Pipeline Co. of America by early this week had laid more than 10 miles of 20-in. pipe for the 60-mile loop in the vicinity of Hoisington, Kans. Approximately 20 miles of 20-in. is on hand in the field.

Construction is being handled by J. R. Horrigan Construction Co. and E. O. Dempsey Construction Co. by a joint-venture agreement entered only for handling this particular project. The job is supervised by U. G. Ralph, superintendent, from headquarters at Hoisington.

The Horrigan organization starts laying 300 miles of 20-in. for Colorado Interstate Gas Co. (Hugoton-Denver) April 15.

Standard of Indiana Fills Minnesota Line

Standard Oil Co. (Ind.) has completed filling its 662-mile products-

Above, B. C. Clardy, president, Stanolind Pipe Line Co., at dewatering and trenching operations near Cleveland, Okla., where a river crossing was made for a 20-in. loop on the company's crude-oil trunk line. B. D. Wilson, Stanolind inspector, stands immediately behind Clardy. Pipe was laid at a depth of 12 ft. below the bed of the Arkansas River, deeper than any laid in this stream. Dewatering was accomplished with five pumps operated in connection with a well-point system. The job was recently completed by Midwestern Constructors within 60 days

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line system of 8-in. and 10-in. pipe connecting the Whiting, Ind., refinery of the company via Joliet, Ill., with Minnesota and Dakota points. Initial filling was with furnace oil.

Stanolind Plans for Fall Construction

Stanolind Pipe Line Co. is postponing the laying of pipe for the 80-mile, 16-in. West Texas extension until September because of delays in pipe deliveries.

During September the company also plans to lay additional loops along its main line in sections between La Plata, Mo., and Manhattan, Ill. These loops will consist of 189 miles of 20-in. and 76 miles of 22-in.

Utah O. & R. Ships Crude to Canada

Utah Oil Refining Co., pipe-line department, has made the first shipment of Rangely crude to Imperial Oil, Ltd., Alberta refineries. The shipment consisted of 12 cars loaded at Utah's new loading rack at Wamsutter, Wyo.

The new rack is equipped to load 24 cars; facilities are capable of handling 7,500 bbl. daily. Crude oil moves from Rangely to Wamsutter by pipe line.

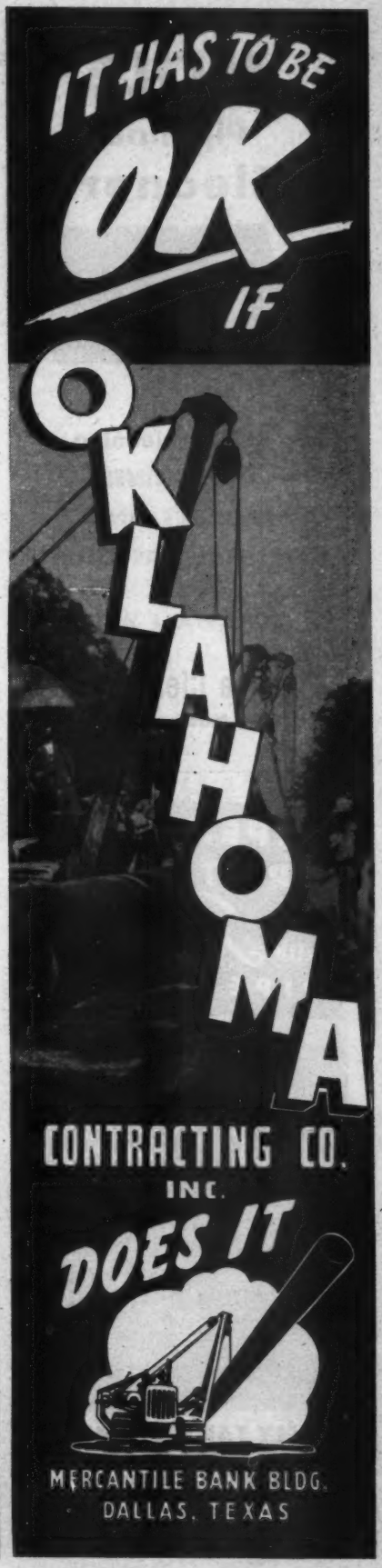
Work Starts on Ohio Fuel Line

For the laying of 45 miles of 16-in. pipe in a replacement job for Ohio Fuel Gas Co., the contractor, Midwestern Constructors, Inc., is establishing headquarters at Granville, Ohio. Carl Bills is spread superintendent. Pipe is scheduled to come coated and wrapped from a Hill-Hubbell & Co. plant at the rate of 8,000 ft. per day.

On March 15 Midwestern Constructors, Inc., was organized to succeed the firm of Midwestern Constructors. Another firm, Midwestern Contractors, Inc., affiliated with the same interests, is opening an office at 122 South Michigan Avenue, Chicago. Howard Lipp, who will be in charge, formerly was assistant chief technical engineer for Peoples Gas, Light & Coke Co., where he had been employed 23 years.

Phillips Opens Division Office at Denver

Phillips Petroleum Co. has opened a division office in its new building at 2185 Broadway, Denver, in preparation for the company's increased activity in the Rocky Mountain area



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which will follow the construction of the 365-mile, 8-in. products pipe line from Borger, Tex., planned for construction later this year. Tankage and loading racks are being built. Definite preparations for pipe laying are waiting until pipe delivery dates may be determined.

Argentine Line to Serve Domestic Market Primarily

Since the 1,100-mile, 10¾-in. natural-gas pipe line from Comodoro Rivadavia to Buenos Aires is planned primarily to serve only the market for domestic cooking and water heating, the volume to be transmitted is smaller than would be handled by a project of this extent in the United States, according to Teofilo M. Tabanera, head of the commission of the Argentine Government's Gas Service Department now in the United States.

Although labor costs for construction, maintenance, and operation would be lower than for similar projects in the United States, Tabanera points out that the total cost of the project would be much larger in terms of Argentine money because of the shipping costs and the rate of exchange. Since the investment in the line will be high, natural-gas transmitted by the line would not be able to compete with fuel oil and wood for industrial use.

Furthermore, the Argentine engineers, including Julio Canessa and Carlos A. Delorme with whom Tabanera is associated in the design of the project, are of the opinion that it is appropriate to plan for transmitting a maximum of only 30,000,000-40,000,000 cu. ft. daily for a 30-year period from reserves estimated to be 15,000,000,000 cu. m. (525,000,000,000 cu. ft.). These various factors have been considered by the commission in reaching the decision to build the 1,100-mile line with a diameter no larger than 10¾-in.

In reviewing the situation, the Argentine engineers feel that they are faced with similar conditions which existed during the early years of pioneering natural-gas lines in the United States, when lines of diameters considerably smaller than 10¾-in. were widely used under conditions where larger diameter lines would be laid according to current practices. The Argentine engineers have the background of experience in building and operating natural-gas lines from the surrounding fields to the city of Mendoza and from La Plata to Buenos Aires.

Construction of the gas line is a part of an Argentine 5-year plan. The pipe-line project will cost an estimated 100,000,000 pesos ($25,000,000). Several weeks ago it was announced that bids for various phases of the construction are being sought from firms in the United States.

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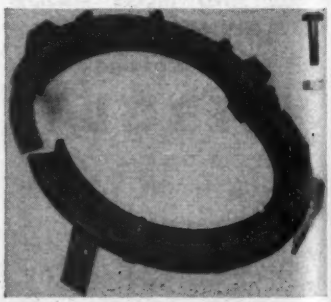

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FOR—
Highway and Right-of-Way Crossings—Wall Sleeves in Pump and Compressor Rooms—Manifolds and Gate Boxes.

THE PIG WITH THE POKE CLEANS PIPE LINES
T. D. WILLIAMSON, INC.

California Joins in Crude Advance

NINE days after crude buyers in other areas posted a 25-cent general price increase, California purchasers, led by Standard Oil Co. of California, followed suit with a similar advance.

The action followed strong appeals for the action from independent producers and suggestions by some that wells be shut in until the increase was given.

Below is shown in its entirety the new posting of Standard of California. Also, starting on this page and continuing on page 120 is the new composite listing of flat prices for representative fields in southwestern, midwestern and Rocky Mountain areas.

Detailed tables showing new crude prices in Southwestern, Midwestern, and Rocky Mountain fields may be found on the following two pages.

New Flat-Price Crude-Oil Table

ARKANSAS

Field, pool, county—	Price $/bbl.
Big Creek*	2.00
Calhoun*	2.00
Columbia*	2.00
Dorcheat-Macedonia (Lime)*	2.00
Dorcheat-Macedonia (Sand)*	2.05
McKamie*	2.00
Smackover (Heavy)	1.63

COLORADO

Field, pool, county—	Price $/bbl.
Florence-Canon City	1.75

ILLINOIS

Basin	2.07
Loudon	2.07
Mattoon	2.07
Mt Vernon	2.07
Plymouth	1.95
Salem	2.07
Woburn	2.07

KENTUCKY

Hitesville	2.07
Robards	2.07
St. Vincent	2.07

LOUISIANA

Bayou Pigeon	1.95
Bear	2.05
Cotton Valley*	2.10
Lisbon*	2.10
Neal (Beauregard Parish)	1.90
Ville Platte	2.05
West Mermanteau	2.05

MICHIGAN

Coldwater	2.14

MISSISSIPPI

Field, pool, county—	Price $/bbl.
Gwinville*	2.05

MONTANA

Cat Creek	2.05
Cut Bank	2.00
Darling	1.80
Gage Dome	2.05

OHIO

Chatham	2.01
Cleveland	2.01
Lodi	2.01

TEXAS

Agua Dulce	2.10
Bateman	1.87
Bazette	1.95
Bee Creek	1.87
Benavides	2.05
Boyle	2.05
Buchanan	1.87
Cayuga	1.62
Chapel Hill	1.88
Chapel Hill*	1.95
Clark	1.84
Clay Creek	1.70
Cleveland	1.96
Columbus	1.87
Conroe	2.13
Darst Creek	1.84
East Texas	1.95
Flag Lake	1.95
Hilbig	1.84
Hobson	1.95
Ira	2.05
Lentz	1.84
Lockhart	2.05
Long Lake	1.93
Longhorn	2.05
Luling-Branyon (Low gravity)	1.75
Luling-Branyon (High gravity)	1.87
Lytton Springs	1.87
Manford	1.84
Mt. Sylvan	1.84

(Continued on Next Page)

Standard Oil Co. of California

Prices Effective March 19

(All Gravities Above Those Quoted Take Highest Price Offered in That Field)

Gravity—	Signal Hill (Long Beach)	Wilmington	El Segundo	Seal Beach	Huntington Beach	Inglewood	Olinda Brea Canon	Athens-Rosecrans	Torrance	Richfield	Whittier, East Coyote (La Habra)	Montebello	West Coyote Hills	Santa Fe Springs	Newhall, Kern River, Kern Front, McKittrick, Round Mountain	Greeley, Wasco, Coles Levee, Elk Hills Stevens Zone	Mountain View	Elk Hills (Shal.), Buena Vista Hills, Midway-Sunset, Lakeview Area	Lost Hills	Coalinga	Wheeler Ridge	Kettleman Hills	Elwood Terrace	Gato Ridge
12-12.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.34	...	...	1.34	1.34	1.34	...	...	...	1.14
13-13.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.36	...	...	1.36	1.36	1.36	...	...	...	1.16
14-14.9	...	...	1.33	...	...	1.36	...	1.35	...	1.35	1.35	1.35	1.37	...	1.38	...	...	1.38	1.38	1.38	...	...	...	1.18
15-15.9	...	...	1.36	...	...	1.40	1.41	1.37	...	1.37	1.36	1.37	1.37	...	1.38	...	...	1.38	1.38	1.38	...	...	...	1.20
16-16.9	...	...	1.37	1.42	...	1.41	1.42	1.38	...	1.38	1.37	1.38	1.38	...	1.39	...	...	1.39	1.39	1.39	...	...	...	...
17-17.9	...	...	1.41	1.43	...	1.42	1.43	1.39	...	1.39	1.38	1.39	1.39	...	1.40	...	...	1.40	1.40	1.40	...	...	...	...
18-18.9	...	1.40	1.45	1.44	...	1.46	1.46	1.43	...	1.40	1.42	1.43	1.41	...	1.41	...	...	1.41	1.41	1.41	...	...	...	...
19-19.9	...	1.45	1.50	1.45	...	1.51	1.50	1.48	...	1.43	1.47	1.47	1.45	...	...	...	1.42	1.42	1.43	1.42	...	...	...	...
20-20.9	...	1.49	1.54	1.46	...	1.56	1.54	1.52	...	1.47	1.52	1.51	1.49	...	...	...	1.43	1.47	1.47	1.44	...	...	...	...
21-21.9	...	1.53	1.57	1.47	...	1.59	1.56	1.56	...	1.51	1.55	1.54	1.51	...	...	...	1.43	1.51	1.50	1.46	...	...	...	...
22-22.9	...	1.57	1.61	1.51	1.49	1.62	1.59	1.59	...	1.54	1.59	1.57	1.54	1.57	...	...	1.45	1.55	1.53	1.49	1.42	...	...	...
23-23.9	...	1.60	1.64	1.55	1.54	1.65	1.62	1.62	...	1.58	1.62	1.60	1.57	1.60	...	...	1.49	1.59	1.55	1.51	1.46	...	...	...
24-24.9	...	1.64	1.67	1.58	1.59	1.67	1.64	1.66	...	1.61	1.66	1.63	1.60	1.62	...	...	1.53	1.63	1.58	1.54	1.50	...	...	...
25-25.9	...	1.68	1.71	1.62	1.63	1.70	1.67	1.69	...	1.64	1.69	1.66	1.63	1.65	...	...	1.57	1.67	1.61	1.56	...	...	...	...
26-26.9	...	1.71	1.74	1.66	1.68	1.72	1.69	1.73	...	1.68	1.73	1.69	1.66	1.68	...	...	1.61	1.71	1.64	1.59	...	...	...	...
27-27.9	...	1.75	1.77	1.69	1.73	1.74	1.72	1.76	1.68	1.71	...	1.72	1.70	1.71	1.69	...	1.65	1.75	1.67	1.61	...	...	...	...
28-28.9	...	1.79	1.81	1.73	1.77	1.76	1.75	1.79	1.72	1.74	...	...	1.73	1.74	1.73	...	1.69	1.79	1.69	1.63	...	...	...	...
29-29.9	...	1.82	1.84	...	1.82	1.78	1.77	...	1.76	...	...	...	1.77	1.76	1.77	...	1.74	1.84	1.72	1.66	...	...	...	...
30-30.9	...	1.86	1.87	...	1.86	1.80	1.80	...	1.80	...	...	...	1.80	1.79	1.80	...	1.65	1.78	1.88	1.75	1.68	...	...	f.o.b. ...
31-31.9	...	...	...	...	1.91	...	1.83	...	1.84	...	...	...	1.84	1.82	1.84	...	1.69	1.82	...	...	1.71	...	...	ship ...
32-32.9	...	...	...	...	1.94	...	...	...	1.88	...	...	...	1.88	1.85	1.88	...	1.72	1.86	...	...	1.73	...	...	... ...
33-33.9	...	...	...	...	...	...	...	...	1.92	...	...	...	1.92	1.87	1.91	...	1.76	1.90	...	...	1.76	...	...	1.85 ...
34-34.9	...	...	...	...	...	...	...	...	1.96	...	...	...	1.96	1.90	1.95	...	1.79	1.94	...	...	1.78	...	...	1.89 ...
35-35.9	...	...	...	...	...	...	...	...	...	...	...	...	2.00	1.93	...	...	1.82	1.98	...	...	...	...	1.86	1.93 ...
36-36.9	...	...	...	...	...	...	...	...	...	...	...	...	2.03	...	...	...	1.86	...	...	...	...	...	1.90	... ...
37-37.9	...	...	...	...	...	...	...	...	...	...	...	...	2.06	...	...	...	1.89	...	...	...	...	...	1.94	... ...
38-38.9	...	...	...	...	...	...	...	...	...	...	...	...	2.08	...	...	...	1.92	...	...	...	...	...	...	... ...
39-39.9	...	...	...	...	...	...	...	...	...	...	...	...	2.11	...	...	...	...	...	...	...	...	...	...	... ...
40-40.9	...	...	...	...	...	...	...	...	...	...	...	...	2.14	...	...	...	...	...	...	...	...	...	...	... ...

New Crude Prices in Southwestern, Midwestern, Rocky Mountain Areas

HOW the 25-cent general crude advance of March 10 affected the price of crude in fields of 13 states is shown in detail in the tabulations on these two pages.

The comprehensive table below shows for each field listed the gravity scales and prices established by all the major producing companies whose postings had been received at the time the compilations were made.

To find the price of crude in a particular field or area, locate the field in the alphabetical listings at the top of the two pages. The number opposite the field's name refers to the column in the gravity-price table below which carries the posting for that field.

FLAT PRICES
TEXAS (Continued)

Field, pool, county—	Price $/bbl.
Pecos (Yates)	
Riddle	1.87
Satsuma	2.10
South Cotton Lake	2.05
Southland	2.05
South Tyler	1.95
Tenney Creek	1.84
Tomball	2.10
United	1.84
Van	1.84
Willamar	1.80
Zoboroski	1.84

WYOMING

Medicine Bow	2.175
Mule Creek	1.71
Osage	2.05

*Distillate.

Areas, Fields, Companies Tabulated by State

ARKANSAS

Field, county or parish, pool, posting company—	Price Sched. Col. No.
Ark. (sour lime)—Standard of N. J.	37
Ark.-N. La. (sweet)—Standard of N. J.	16
Ark.-N. La. (Rodessa)—Standard of N. J.	5
Miller—Magnolia	18
Schuler (Jones Sand)—Phillips*	37
Stephens—Ohio Oil	3

*Starts: Below 21.

COLORADO

Fort Collins, Wellington—Continental	9
Iles—Standard (Ind.)	2
Rangely—Standard (Ind.)	14
Walden—Continental	13

ILLINOIS-INDIANA

Eastern Illinois and Western Indiana —Ohio Oil Co.	4

KANSAS

All fields—Carter, Continental, Gulf, Phillips, Shell, Standard (Ind.), White Eagle*	2
Pure	15
Cities Service, Sinclair Prairie, Sohio, Texas Co.	5

*Starts: 21-21.9.

LOUISIANA

Avery Island, etc.—Texas Co.	11
Bayou Mallet, etc.; Hemphill, etc.—Standard of N. J.	17
Big Creek, Delhi, etc.—Standard of N. J.	5
Big Lake, Tepetate, etc.—Continental	11
Black Bayou (lt.), etc.—Shell	11
Caddo—Stanolind, Magnolia	18
Catahoula Lake, etc.—Standard of N. J.	24
Charenton (below 28°)—Pan American Prod.	21
Delhi, etc.—Sohio*	5
Gulf Coast (with exceptions)—Texas Co.	11
Hackberry—Stanolind	20
Hackberry, Chacahoula, etc.—Sun	25
Jefferson Davis—Sohio	11
Jennings—Stanolind	19
La Place, Sorrento, etc.—Pan American Prod.	11
Little Cr., etc.; Coastal La.—Standard of N. J.	11

Prices According to Gravity

A.P.I. gravity—	Montana, Wyoming 1	Okla., Kans., Mont., Wyo. 2	Arkansas 3	Indiana, Illinois 4	Nebraska, Texas 5	Louisiana 6	Wyoming, Texas 7	Wyoming 8	Colorado 9	New Mexico 10	Louisiana, Texas 11	Texas 12	N. Texas 13	Colorado 14	Oklahoma, Kansas 15	Arkansas, Louisiana 16	Louisiana, Mississippi 17	Arkansas, Louisiana 18	Louisiana 19	Louisiana 20	Louisiana 21	Texas 22	Texas 23
15-15.9	1.20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16-16.9	1.225	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17-17.9	1.25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18-18.9	1.275	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19-19.9	1.30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Below 20	...	...	...	...	1.53	...	1.40	...	...	...	1.63	1.73	...	...	...	1.51	1.58	...	...	...	...	...	...
20-20.9	1.325	...	...	...	1.55	...	1.42	...	...	...	1.65	1.75	...	...	...	1.53	1.60	...	...	...	...	...	...
Below 21	...	1.55	...	...	...	...	...	...	...	...	...	...	...	1.45	...	...	...	...	...	...	...	...	...
21-21.9	1.35	1.57	...	...	1.57	...	1.44	...	...	...	1.67	1.77	...	1.47	...	1.55	1.62	...	...	...	...	...	...
22-22.9	1.375	1.59	...	...	1.59	...	1.46	...	...	...	1.69	1.79	...	1.49	...	1.57	1.64	...	...	...	...	...	...
23-23.9	1.40	1.61	...	...	1.61	...	1.48	...	...	...	1.71	1.81	...	1.51	...	1.59	1.66	...	...	...	...	...	...
Below 24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.84	1.94	...	...
24-24.9	1.425	1.63	...	...	1.63	...	1.50	...	...	...	1.73	1.83	...	1.53	...	1.61	1.68	...	...	1.86	1.96	...	...
Below 25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.63	...	...	...	1.65	1.50
25 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25-25.9	1.45	1.65	1.63	...	1.65	...	1.52	...	...	...	1.75	1.85	...	1.55	1.65	1.63	1.70	1.65	...	1.88	1.98	1.67	1.52
26-26.9	1.475	1.67	1.65	...	1.67	...	1.54	...	...	...	1.77	1.87	...	1.57	1.67	1.65	1.72	1.67	...	1.90	2.00	1.69	1.54
27-27.9	1.50	1.69	1.67	...	1.69	...	1.56	...	...	...	1.79	1.89	...	1.59	1.69	1.67	1.74	1.69	...	1.92	2.02	1.71	1.56
28-28.9	1.525	1.71	1.69	...	1.71	...	1.58	...	...	...	1.81	1.91	...	1.61	1.71	1.69	1.76	1.71	...	1.94	...	1.73	1.58
Below 29	...	...	...	1.93	...	...	...	1.56	1.66	1.58	...	...	1.71	...	...	...	...	...	...	...	...	...	...
29 and below	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29-29.9	1.55	1.73	1.71	1.95	1.73	...	1.60	1.58	1.68	1.60	1.83	1.93	1.73	1.63	1.73	1.71	1.78	1.73	...	1.96	...	1.75	1.60
30 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30-30.9	1.575	1.75	1.73	1.97	1.75	...	1.62	1.60	1.70	1.62	1.85	1.95	1.75	1.65	1.75	1.73	1.80	1.75	...	1.98	...	1.77	1.62
31-31.9	1.60	1.77	1.75	1.99	1.77	...	1.64	1.62	1.72	1.64	1.87	1.97	1.77	1.67	1.77	1.75	1.82	1.77	...	2.00	...	1.79	1.64
Below 32	...	...	...	...	...	1.90	...	...	...	...	...	...	...	...	...	...	...	...	1.82	...	...	...	...
32 and above	1.625	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32-32.9	...	1.79	1.77	2.01	1.79	1.92	1.66	1.64	1.74	1.66	1.89	1.99	1.79	1.69	1.79	1.77	1.84	1.79	1.84	2.02	...	1.81	1.66
33-33.9	...	1.81	1.79	2.03	1.81	1.94	1.68	1.66	1.76	1.68	1.91	2.01	1.81	1.71	1.81	1.79	1.86	1.81	1.86	2.04	...	1.83	1.68
Below 34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
34 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.06	...	...	...
34-34.9	...	1.83	1.81	2.05	1.83	1.96	1.70	1.68	1.78	1.70	1.93	2.03	1.83	1.73	1.83	1.81	1.88	1.83	1.88	...	...	1.85	1.70
35 and above	...	...	...	2.07	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
35-35.9	...	1.85	1.83	...	1.85	1.98	1.72	1.70	1.80	1.72	1.95	2.05	1.85	1.75	1.85	1.83	1.90	1.85	1.90	...	...	1.87	1.72
36 and above	...	...	...	...	...	2.00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36-36.9	...	1.87	...	...	1.87	...	1.74	1.72	1.82	1.74	1.97	2.07	1.87	1.77	1.87	1.85	1.92	1.87	1.92	...	...	1.89	1.74
37-37.9	...	1.89	...	...	1.89	...	1.76	1.74	1.84	1.76	1.99	2.09	1.89	1.79	1.89	1.87	1.94	1.89	1.94	...	...	1.91	1.76
38-38.9	...	1.91	...	...	1.91	...	1.78	1.76	1.86	1.78	2.01	2.11	1.91	1.81	1.91	1.89	1.96	1.91	1.96	...	...	1.93	1.78
39-39.9	...	1.93	...	...	1.93	...	1.80	1.78	1.88	1.80	2.03	2.13	1.93	1.83	1.93	1.91	1.98	1.93	1.98	...	...	1.95	1.80
40 and above	...	1.95	...	...	1.95	...	1.82	1.80	1.90	1.82	2.05	2.15	1.95	1.85	1.95	1.93	2.00	1.95	2.00	...	...	1.97	1.82

Field, county or parish, pool, posting company—	Price Sched. Col. No.
Lockport, Cameron, etc.—Magnolia	42
Mamou—Magnolia	11
St. Gabriel (F sand type)—Shell	30
Venice—Tide Water	6
*Starts: Below 24°—$1.61.	

MISSISSIPPI

Brookhaven, etc.—Standard of N. J., Sohio	17
Miss. hvy. sour—Standard of N. J.	46
Pickins—Carter*	24
Tinsley—Sohio	24
*Starts: 24-24.9.	

MONTANA-WYOMING

East Mahoney dome—Sinclair-Wyoming	8
Elk Basin—Stanolind	2
Elk Basin (Tensleep), Frannie (lt.), Oregon Basin—Carter	1
Elk Basin (Tensleep)—Stanolind	1
Grass Creek—Standard (Ind.)	2
Hamilton Dome, etc.—Standard (Ind.)	1
Lance Creek, etc.—Carter, Continental	2
Lance Creek, etc., and Elk (lt.)—Ohio Oil	2
Lost Soldier, Bailey Dome, Crooks Gap (except Tensleep)—Sinclair-Wyoming	2
Lost Soldier, etc. (Tensleep)—Sinclair-Wyoming	7
Oregon Basin and Elk (hvy.)—Ohio Oil	1
Salt Creek (except Tensleep)—Stanolind	2
Salt Creek (Tensleep)—Stanolind	1

NEBRASKA

Barada, Falls City—Skelly	5

NEW MEXICO

Field, county or parish, pool, posting company—	Price Sched. Col. No.
Brunson, Drinkard—Magnolia	41
Brunson, Drinkard—Sinclair Prairie, Texas Co., Shell, Cities Service	24
Eddy, Lea—Continental	10
Lea—Stanolind	36
Lea (with exceptions)—Humble, Magnolia, Atlantic, Texas Co., Shell, Cities Service	7
Gulf,* Sinclair Prairie (with exceptions)	23
*Starts: Below 26°. $1.52.	

OKLAHOMA

All fields—Bell, Ben Franklin, Carter, Champlin, Continental, Gulf, Magnolia, Mid-Continent, Phillips, Shell, Standard (Ind.), Tide Water, Wilcox	2
Oklahoma City, Cement—Anderson-Prichard*	2
Pure (except North Hobart, Keyes)	15
Sinclair Prairie, Sohio, Texas Co.	5
*Starts: Below 11°—$1.25.	

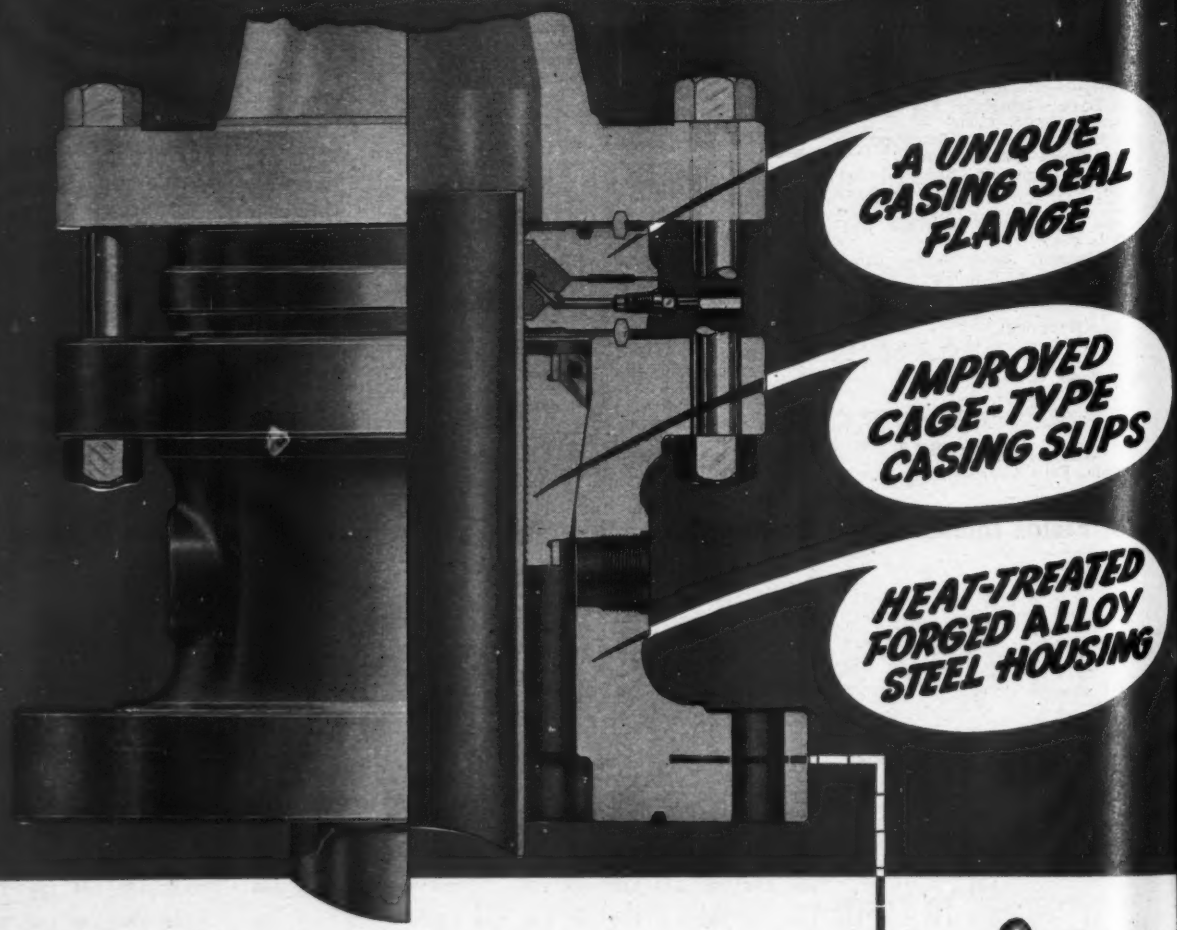
TEXAS

Abell, etc.—Sinclair Prairie, Magnolia	18
Agua Dulce—Sinclair Prairie	29
Aldine, Clodine, etc.—Stanolind	39
Alta Loma—Pan American Prod.	29
Anderson, etc.—Humble	33
Anahuac, Angleton, etc.—Humble, Sun*	29
Armstrong, etc.—Humble	12
Barbers Hill—Atlantic	44
Carson, Gray, etc.—Magnolia	13
Cass, Harrison, etc.—Magnolia	18
Charlotte, etc.—Humble	31
Clinton, Lake Cr., etc.—Stanolind	38
Coastal Grade A—Sinclair Prairie	26
Coastal Grade A—Sun	35
Delhi, etc.—Sun*	5
Dickinson, etc.—Humble	11
Dyersdale, Trinity, etc.—Stanolind	35
Egan—Sun*	11
Gillock-Dickinson, etc.—Pan American Prod.	11
Guerra—Sun*	12
Gulf Coast—Humble	26
Gulf Coast—Sinclair Prairie, Sun	25
Hastings, etc.—Humble, Pan American Prod.	30
Hawkins, etc.—Humble	34
Hendrick, etc.—Stanolind	7
High Island—Stanolind	30
Howard, Glasscock, etc.—Col-Tex Ref.	7
Jackson—Magnolia	43
Jay Welder—Stanolind	29
Mexia District—Sinclair Prairie	22
Mirando—Magnolia, Sinclair Prairie, Humble, Sun	27
North Texas—Continental, Panhandle Ref., Magnolia	13
North Texas—Stanolind, Bell	2
N. Cent. Texas—Sohio	5
Pearsall—Humble	32
Quitman—Pan American Prod.	40
Refugio—Humble	28
Refugio, Greta—Atlantic	45
Seeligson, etc.—Magnolia	29
Spindletop—Stanolind	26
Starr County—Continental	12
Wade City, Clara Driscoll—Sinclair Prairie	28
West Texas—Atlantic, Humble, Magnolia, Gulf, Shell, Cities Service	7
West Texas—Phillips, Stanolind	36
West Texas—Sinclair Prairie	23
W. Cent. Texas—Humble	5
W. Cent. Texas—Panhandle Ref.	15
*Starts: Below 24°.	

For Fields Included and Posting Companies, Refer to Corresponding Column Number in Tabulation Above

A.P.I. gravity—	N. Mexico, Mississippi	Texas	Texas	Texas	Texas	Texas	Texas	Texas	Texas	Texas	Texas	Texas	Texas	Arkansas	Texas	Texas	Texas	N. Mexico	Louisiana	Texas	Texas	Texas	Mississippi
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
15-15.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16-16.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17-17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18-18.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19-19.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Below 20	1.46	...	...	...	1.78	1.68	1.76	1.50	1.45	1.55	1.50	...	...	1.44	...	...	1.48	...	1.73	1.73	1.86	...	1.36
20-20.9	1.48	...	...	...	1.80	1.70	1.78	1.52	1.47	1.57	1.52	...	...	1.46	...	...	1.50	...	1.75	1.75	1.88	...	1.38
Below 21	...	...	...	...	...	...	...	...	...	...	...	...	1.42	1.46	1.78	1.65	...	...	...	...	...	1.80	...
21-21.9	1.50	...	...	...	1.82	1.72	1.80	1.54	1.49	1.59	1.54	...	1.44	1.48	1.80	1.67	1.52	...	1.77	1.77	1.90	1.82	1.40
22-22.9	1.52	...	...	...	1.84	1.74	1.82	1.56	1.51	1.61	1.56	...	1.46	1.50	1.82	1.69	1.54	...	1.80	1.79	1.92	1.84	1.42
23-23.9	1.54	...	...	...	1.86	1.76	1.84	1.58	1.53	1.63	1.58	...	1.48	1.52	1.84	1.71	1.56	...	1.83	1.81	1.94	1.86	1.44
Below 24	...	1.84	1.94	1.91	...	...	...	...	...	...	...	1.94	...	...	...	...	...	...	...	...	...	...	...
24-24.9	1.56	1.86	1.96	1.93	1.88	1.78	1.86	1.60	1.55	1.65	1.60	1.96	1.50	1.54	1.86	1.73	1.58	...	1.86	1.83	1.96	1.88	1.46
Below 25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.56	...	...	...	...	...
25 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25-25.9	1.58	1.88	1.98	1.95	1.90	1.80	1.88	1.62	1.57	1.67	1.62	1.98	1.52	1.56	1.88	1.75	1.60	1.58	1.89	1.85	1.98	1.90	1.48
26-26.9	1.60	1.90	2.00	1.97	1.92	1.82	1.90	1.64	1.59	1.69	1.64	2.00	1.54	1.58	1.90	1.77	1.62	1.60	1.92	1.87	2.00	1.92	1.50
27-27.9	1.62	1.92	2.02	1.99	1.94	1.84	1.92	1.66	1.61	1.71	1.66	2.02	1.56	1.60	1.92	1.79	1.64	1.62	1.94	1.89	2.02	1.94	1.52
28-28.9	1.64	1.94	2.04	2.01	1.96	1.86	1.94	1.68	1.63	1.73	1.68	2.04	1.58	1.62	1.94	1.81	1.66	1.64	1.96	1.91	2.04	1.96	1.54
Below 29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 and below	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 and above	...	...	...	2.03	...	...	...	...	...	...	1.70	2.06	...	...	...	...	...	...	...	...	...	...	...
29-29.9	1.66	1.96	2.06	...	1.98	1.88	1.96	1.70	1.65	1.75	...	...	1.60	1.64	1.96	1.83	1.68	1.66	1.98	1.93	2.06	1.98	1.56
30 and above	...	...	2.08	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.58
30-30.9	1.68	1.98	...	...	2.00	1.90	1.98	1.72	1.67	1.77	...	...	1.62	1.66	1.98	1.85	1.70	1.68	2.00	1.95	2.08	2.00	...
31-31.9	1.70	2.00	...	...	2.02	1.92	2.00	1.74	1.69	1.79	...	...	1.64	1.68	2.00	1.87	1.72	1.70	2.02	1.97	2.10	2.02	...
Below 32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32-32.9	1.72	2.02	...	...	2.04	1.94	2.02	1.76	1.71	1.81	...	...	1.66	1.70	2.02	1.89	1.74	1.72	2.04	1.99	2.12	2.04	...
33-33.9	1.74	2.04	...	...	2.06	1.96	2.04	1.78	1.73	1.83	...	...	1.68	1.72	2.04	1.91	1.76	1.74	2.06	2.01	2.14	2.06	...
Below 34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
34 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.08	...	2.16	...	...
34-34.9	1.76	2.06	...	...	2.08	1.96	2.06	1.80	1.75	1.85	...	...	1.70	1.74	2.06	1.93	1.78	1.76	...	2.03	...	2.08	...
35 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.05	...	...	...
35-35.9	1.78	2.08	...	...	2.10	2.00	2.08	1.82	1.77	1.87	...	...	1.72	1.76	2.08	1.95	1.80	1.78	...	...	...	2.10	...
36 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36-36.9	1.80	2.10	...	...	2.12	2.02	2.10	1.84	1.79	1.89	...	...	1.74	1.78	2.10	1.97	1.82	1.80	...	...	...	2.12	...
37-37.9	1.82	2.12	...	...	2.14	2.04	2.12	1.86	1.81	1.91	...	...	1.76	1.80	2.12	1.99	1.84	1.82	...	...	...	2.14	...
38-38.9	1.84	2.14	...	...	2.16	2.06	2.14	1.88	1.83	1.93	...	...	1.78	1.82	2.14	2.01	1.86	1.84	...	...	...	2.16	...
39-39.9	1.86	2.16	...	...	2.18	2.08	2.16	1.90	1.85	1.95	...	...	1.80	1.84	2.16	2.03	1.88	1.86	...	...	...	2.18	...
40 and above	1.88	2.18	...	...	2.20	2.10	2.18	1.92	1.87	1.97	...	...	1.82	1.86	2.18	2.05	1.90	1.88	...	...	...	2.20	...

This is the New CAMERON *Forged Steel* CASING HEAD



This huge hydraulic press converts a hot steel billet into a casing head in a matter of minutes!

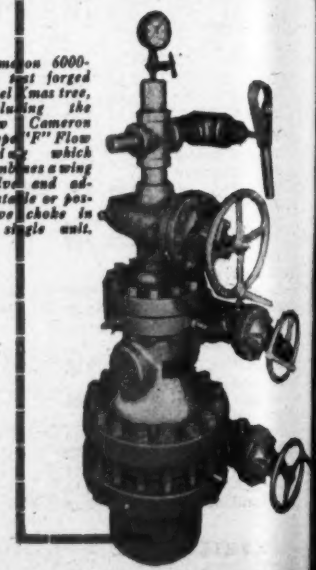
Out of the big new 5000-ton Cameron hydraulic forge press comes a new line of well heads to set higher standards for quality and economy in the intermediate pressure range—4000-6000 lbs. test.

The Type "F" Casing Spool shown above is press forged from alloy steel to produce a leak proof, high-tensile strength product, yet the unit is priced economically in keeping with the market for which it was designed.

The seal flange is an innovation in casing seals. Note in the cutaway view that it bolts down between the casing head and tubing head flanges, utilizing flange bolt compression to force the packing ring into sealing engagement with the pipe. The seal flange is available with provision for hydraulic pressure testing, as shown, or plain. Its simplified design requires no special skill for installing—the operators own crew can perform this operation.

The forged steel slips, in six segments, provide dependable suspension for the casing string. The segments are contained in a cage, providing a two-piece slip that is easily assembled around the casing.

Pictured at right is a Cameron *all-forged steel* Christmas tree (except valves) assembled above a Type "F" Casing Head. Complete details on each unit of this assembly will gladly be sent to interested operators on request.



Cameron 6000-lb. test forged steel Xmas tree, including the new Cameron Type "F" Flow Wing which combines a wing valve and adjustable or positive choke in a single unit.

CAMERON IRON WORKS, INC.

P. O. BOX 1212, HOUSTON, TEXAS

Export: 74 Trinity Place, New York, N. Y. West Texas: Odessa, Telephone (1710). California: 1442 Hayes Ave., Long Beach (7-2036). Oklahoma: 310 Thompson Bldg., Tulsa. Wyoming: 356 N. Wolcott St., Casper. North Louisiana: Bossier City (P. O. Box 425).

Exploration and Drilling

A.A.P.G Puts Official Sanction on Research Committee Projects

by Charles J. Deegan

TWO years of hard work by the research committee had its reward at Los Angeles, when the American Association of Petroleum Geologists, through action by both the executive and business committees, put its official sanction on the research projects outlined, highly commended work of the research unit, and threw full weight of the association's powerful influence behind the approved projects.

The next news probably will be the announcement within a few weeks that financial sponsorship has been secured for various segments of these projects. While financial support probably can be obtained from the military research organization that represents both the Army and Navy, prevailing sentiment at Los Angeles was in favor of keeping the research work in the hands of the industry if possible, rather than becoming involved with governmental agencies. If the American Petroleum Institute's forthcoming action on proposed financing through its research committee is favorable, the work will be kept in the industry's hands.

The association also commended the work of the military-geology unit of the United States Geological Survey, which developed new techniques and applications of geology to terrain intelligence during the recent war. Continuation of the work of this unit, under proper safeguards, during peacetime was endorsed.

Membership in all the exploratory societies grew steadily during 1946, and the geologists were told that increased interest in foreign oil was reflected by a 17 per cent growth in membership outside the United States, in contrast to a 7 per cent growth in domestic membership. There are now more South American members in A.A.P.G. than the total for any one state except the big three, Texas, Oklahoma, and California.

Two new affiliated local societies were added to A.A.P.G., when the applications of the Abilene, Tex., Geological Society and Associao Brazileria de Petroleo were approved.

There were two significant sidelight items that show the trend toward greater interest in, and appreciation of the work of the exploratory scientists. One was the general comment among research committee members that the companies were giving unstinted cooperation in the work, and that this was particularly noticeable in the way in which requests for assignment of men for certain work were met. Not only were the requests granted quickly, but the men assigned were usually the top men in that field on the company's payroll.

Public Interest Increasing

The other conspicuous trend was the increased interest of the general public in petroleum, and particularly in the question of the sufficiency of future supplies. This increased public interest was reflected in the amount of newspaper coverage of the exploration societies' programs, and the number of personal interviews handled in press conferences. The efficient arrangements of the California host scientists for handling such publicity was an important factor, but without the widespread general public interest, the newspaper coverage of the convention would not have been nearly as extensive.

The geophysicists' meeting brought out quite a number of new instruments, or modifications of older instruments. Most striking, of course, were the numerous papers on airborne or mobile magnetometers, and discussions of various radar methods of surveying for position fixing. All geophysical reconnaissance instruments have now reached the stage where the surveying involved is the bottleneck that cuts down speed. With rapid strides in the making toward air-mounted instruments for observation of the various physical properties of the earth, the old-style methods of determining the location of the instrument simply will not do.

There was some comment among geophysicists to the effect that they had been forced to stop their main line of attack and go into the field of developing new surveying instruments, because the old-line producers of such equipment had not kept pace with them.

Continental Shelf Exploration

Interest in Continental Shelf exploration continues to increase, and it was noticeable that all sessions at which the various papers dealing with geophysical developments and instrumental techniques in underwater work were presented had exceptionally heavy attendance.

After the previous regional meetings at Biloxi and Wichita had revealed the prevailing optimistic sentiment among geologists about the prospects of finding enough oil in the future, it was not surprising to find the same thing still good at Los Angeles. As the newspaper reporters found out, sometimes to their surprise, the men who have the responsibility for finding future oil are not the pessimists. However, some California geologists are not so sure that they can meet the future demands in that area from local supplies, unless some of the prospecting territory in adjoining states brings in new additions.

The field trips which followed the end of the formal program attracted a larger group than had been anticipated. Many committee members had been in Los Angeles for several days prior to the opening of the formal program, during which time they carried a heavy load of work and planning. The bulk of the out-of-state members present arrived on either Sunday or Monday. Despite this long siege of work, a substantial number went on the 3-day field trip that did not end until Sunday night.

While there was no official announcement, it is understood that there is a strong probability that next year's convention will be held in Denver, the home town of President Dobbin of A.A.P.G. There will be at least one regional A.A.P.G. meeting, at San Antonio, the request of the San Antonio group having been acted upon favorably.

SOUTH LOUISIANA

Barnsdall Has Third Well in Longville Area

NEW ORLEANS.—A third well has been completed by Barnsdall Oil Co. in its Longville discovery area of Beauregard Parish. It is the 3 Long Bell Lumber Co., SW NW 6-6s-9w, ½ mile east of the 1 Long Bell discovery. The well is completed approximately 48 ft. higher than the discovery well with perforations at 8,184-8,203 ft. A potential gage of 307 bbl. of 49.1°-gravity pipe-line oil daily was recorded. Flowing pressure was 700 psi. with 900 psi. pressure on the casing. Total depth of the exploration was 8,640 ft. Derrick and materials have been moved to a new test in the area, 1 M. E. Cooley Estate, north offset to the current producer and in Section 6-6s-9w.

Humble Oil & Refining Co. announced failure of two deep wildcat explorations in St. Mary Parish. In the Shell Island area, its 1 Rose Phillip Feitel et al, bottomed at 11,920 ft., was abandoned after a considerable amount of trouble was experienced with the well attempting to gas. The other failure was the 1 State-Hogg Bayou on State Lease 732, in the Atchafalaya Bay, in 18s-10e, which was plugged and abandoned with no favorable showings to a total depth of 13,423 ft. Another St. Mary Parish abandonment was Fifteen Oil Co.'s deep exploration in the Chareton field, 10 South Coast Co., Section 26-13s-10e. It missed the field sands to a total depth of 7,997 ft.

Magnolia Petroleum Co. has decided to make further tests in its northeast Mud Lake discovery of Cameron Parish. The well, 1-C Lutcher in Section 24-14s-11w, flowed a gage of 17.5 bbl. of condensate daily with 3,907,000 cu. ft. of gas daily through 12/64-in. choke with 3,740 psi. flowing pressure on the tubing from 93 perforations at 11,272-309 ft. A plug was set to pack off the perforated level, and a new test was being made through 293 perforations shot from 10,762-832 ft. The company has completed roads and is moving in materials for a confirmation test of the area. This will be the 1 Vincent Estate approximately 3,400 ft. northeast of the discovery and in Section 18-14s-10w.

Other new wildcat explorations slated for the South Louisiana district included a wildcat in the Eola field area a new deep exploration of the Johnsons Bayou area, Avoyelles and Cameron parishes, respectively. Atlantic Refining Co. will drill the Eola test 1½ miles west of most southerly production in Eola field, and it will be known as 1 Haas Investment Co., Inc., Section 10-2s-2e. At Johnson's Bayou in Cameron Parish, Stanolind Oil & Gas Co. located 1 George J. McManus, which will be just north of the shore line of the Gulf of Mexico, and in Section 20-15s-14w. It will be a 9,500-ft. project.

Two successful wildcat completions were made in the South Louisiana district in the past week, the New Gas field at Grand Chenier in Cameron Parish, and a new deep gas-producing horizon in Bon Air field of Jeff Davis Parish, both by Sohio Petroleum Co. One wildcat failure was reported, in Iberia Parish. Proven areas reported two new gas wells, two oilers, and one dry hole.

SOUTH LOUISIANA SUCCESSFUL WILDCATS

Cameron Parish: New gas-condensate pool, Grand Chenier—Sohio Pet. Co. 1 Charles Richard, ctr SW SW 1-15s-5w, 9 mi. SW of Pecan Lake field and 8 mi. SE of Little Chenier gas field, TD 11,020 ft., perf. 8,380-90 ft., IP flowed gas and spray of condensate through 10/64-in. choke, shut in, no gage TP 3,100 psi., no water.

Jefferson Davis Parish: New gas-condensate pay, Bon Air pool—Sohio Pet. Co. 4-B Claudius Fontenot, 16-10s-6w, IP: 1,155,000 cu. ft. gas and 5.72 bbl. condensate per day through ⅛-in. choke, GOR 202,000, TP 3,550 psi., gravity 50.5°, no water.

SOUTH LOUISIANA WILDCAT FAILURE

Iberia Parish: Falcon-Seaboard Drlg. Co. et al 1 Willie Lopez, 1-12s-5e, 5 mi. NE Jefferson Island field, dry, TD 11,608 ft.

N. CENTRAL TEXAS

Ashland Oil Trying for Ellenburger Production

WICHITA FALLS.—Ashland Oil & Refining Co. late last week was still trying to establish Ellenburger production on the northwest flank of Mills field in Baylor County. The test, 1 L. V. Martin, Block 3,114, TE&L Survey, 1 mile southeast of the town of Westover, perforated casing with 150 shots at 5,412-38 ft. and bailed slightly more than 1 bbl. of oil, plus some water, an hour.

In Montague County, 3 miles southeast of the townsite, Continental Oil Co. 1 P. Magee, in the C. A. Wright Survey, reported a recovery of 420 ft. of heavily oil-cut mud on a drill-stem test at 6,024-33 ft. The mud contained 50 per cent oil and no water. Shows of oil were found in a sand at 6,033-45 ft.

The new Eskota field of southeastern Fisher County was given an offset completion last week at Skelly Oil Co. 5-A D. O. Huddleston, Section 11, Block 19, T&P Survey. Initial potential was 141 bbl. of oil a day, flowing through ¾-in. choke, from reef limestone pay at 4,292-4,419 ft. Casing pressure was 600 psi., and tubing pressure was 115 psi.

In Throckmorton County, Fred M. Manning, Inc. 1 R. A. Brown Cattle Co., ½-mile northeast extension to the Record Mississippian limestone field, 9 miles south of Throckmorton, was ready for completion after a second acid treatment. The well was said to be flowing oil but the amount was not disclosed. It was reported shut in for connections.

Expansion of the rapidly developing Parrott field of southeastern Throckmorton County was given a boost last week when Manning, Potts & Craig staked outposts on the west side of the field. Manning was said to be moving in rotary for a 4,500-ft. test which is to be the 1 James R. Marshall, Section 949, TE&L Survey; while Potts & Craig will drill the 2 Whitaker, Section 596, TE&L Survey, to 4,000 ft. with rotary tools. The latter location is 1,071 ft. south of their 1 Whitaker. In the same area, Potts & Craig 1 Crump, Section 956, was completed for a flowing potential of 191.8 bbl. of 41°-gravity oil in 3 hours and 20 minutes. Production was through ¾-in. choke from perforations at 3,943-49 ft. Gas-oil ratio was 900:1.

NORTH CENTRAL TEXAS SUCCESSFUL WILDCATS

Cooke County: Phillips Petroleum Co. 1 Atcheson, J. Davis Sur., 10 mi. S Muensster, flowed 80 bbl. 42°-gravity oil in 3 hours, 32/64-in. choke, limestone pay 1,936-82 ft., TD 2,066 ft., GOR 117:1.

Foard County: Stanolind Oil & Gas 1 J. G. Halsell, J. Shearer Sur., 6 mi. SE Crowell, pumped 16 bbl. 39°-gravity oil, perf. in limestone 4,822-38 ft., TD 5,912 ft., PB 5,762 ft.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Archer County: G. E. Kadane & Sons 1-AA W. T. Waggoner Estate, 3 mi. N Dundee, dry, TD 1,670 ft. in sand, with show of oil.

Cooke County: Lloyd Oil Co. 1 R. G. Daniel, M. J. Buckelew Sur., 3½ mi. NW Woodbine, dry, TD 2,501 ft., sand with slight show oil 2,494 ft.

Knox County: Doyle Petroleum Corp. 2 Ross Bates "A," Sec. 1, H&TC Sur., 3 mi. E Goree, dry, TD 1,635 ft. in limestone and sand.

Doyle Petroleum 1, Kuhler Bros., Sec. 3, D&W Sur., 3 mi. E Goree, dry, TD 1,700 ft. in broken sand and limestone.

Wilbarger County: Buffalo Oil Co. 1 E. S. Smith, Sec. 14, H&TC Sur., 3 mi. SE Oklaunion, dry, TD 4,560 ft., Canyon 3,880 ft.

WEST CENTRAL TEXAS WILDCAT FAILURES

Callahan County: R. Kaymon 1 H. M. Kennard, Sec. 26, ETRR Sur., 8 mi. N Clyde, dry, TD 1,895 ft. in sandy limestone, Saddle Creek 1,521 ft., upper Hope 1,635 ft., lower 1,688-1,737 ft., Gunsight 1,806 ft., King 1,836 ft.

Jones County: West Central Drilling Co. 1 E. H. Reeves, M. R. Longorio Sur., 4 mi. S Truby, dry, TD 4,286 ft., Saddle Creek 2,220 ft., Gunsight 2,577 ft., Reef 3,600 ft.

Shackelford County: H. J. Cox et al Oma Townsend, Sec. 46, LAL Sur., 4 mi. SW Moran, dry, TD 2,250 ft., slight show of oil in limestone at 2,008-09 ft.

Taylor County: West Central Drilling Co. 1 Jessie Brown, Sec. 30, Blk. 17, T&P Sur., 2 mi. NE Tye, dry, TD 2,747 ft., Coal 2,280 ft., Flippen 2,292 ft., Gunsight 2,571 ft., King 2,630 ft.

Throckmorton County: Blackwell Oil & Gas Co. 1 W. L. Everett, Sec. 2,240, T&P Sur., 3 mi. SE Woodson, dry, TD 4,651 ft., Palo Pinto 1,982 ft., Caddo 3,812 ft., Barnett 4,555 ft., Mississippi 4,605 ft.

APPALACHIAN FIELD

Gordan Sand Failures on Two Sides of Young Pool

PITTSBURGH.—In North Strabane Township, Washington County, southwest Pennsylvania, Charles E. Young et al drilled through Gordon sand in an eastern test of the Young pool on the Paul Gulla farm. It was void of production and is being drilled to the Fifth sand. Near the western edge of the Young pool, John Yoney et al drilled a second test on the Yoney tract, which also failed in the Gordon, but will make a light gas well in the Injun sand.

In Sugar Grove Township, Warren County, T. M. Pettigrew et al drilled to 4,264 ft., set casing at 4,185 ft. in the wildcat on the Anderson farm which cased off the water that broke in at 3,974 ft. Red Medina was topped at 4,211 ft.

New locations in southwest Pennsylvania totaled three, one each in Kittanning, Plum Creek, and Sugar Creek townships, Armstrong County. Several wells have started deepening in Armstrong, Indiana, and Washington counties.

In Elk district, Kanawha County, West Virginia, United Fuel Gas Co. completed a test, 5,803 Lewis Hubbard Corp., with a final gage, after shot, of 6,048,000 cu. ft. gas from the Oriskany sand. From a surface elevation of 877 ft. the Corniferous was logged at 5,084 ft., Oriskany 5,200-31 ft., gas 5,214-26 ft., shot 5,200-31 ft., total depth 5,231 ft.

In Union district, Wayne County, Morrison Gas Co. completed a good test on John Morrison farm with open flow of 1,469,000 cu. ft. gas from Brown shale, total depth 2,970 ft., surface elevation 601 ft.

In Baileysville district, Wyoming County, United Producing Co. completed 1,388 W. M. Ritter Lumber Co. good for 1,309,000 cu. ft. gas from the Berea after shot. The Maxton sand gaged 169,000 cu. ft., Big Lime topped at 2,524 ft., Berea 3,592-3,625 ft., shot 3,610-25 ft., rock pressure 735 lb. 66 hours, total depth 3,628 ft.

New locations in West Virginia totaled 12, located in Scott district, Boone County; Southwest district, Doddridge County; Harts Creek and Laurel Hill districts, Lincoln County; Jefferson district, Nicholas County; McKim district, Pleasants County; Clay

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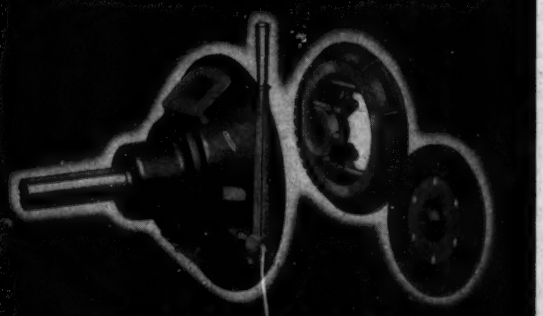

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EASTERN TEXAS

Cherokee County Test Shows Gas in Upper Bacon

DALLAS.—Standard Oil Co. 1 New Birmingham Development Co., Cherokee County, plugged back from 10,017 ft. to 8,656 ft. A drill-stem test in the upper Bacon at 8,606-30 ft. and 8,638-52 ft., with the packer set at 8,568 ft., open 15 minutes, flowed gas under 600 lb. surface pressure, through 11/16-in. choke. Shut in, tubing pressure rose to 4,500 lb. Operators killed the well to rerun casing and make another test of the Bacon. The James limestone was gaged at 125,000 cu. ft. of gas and some salt water, and the lower Bacon at 380,000 cu. ft. of gas, with some distillate and some salt water. A third drill-stem test failed and operators shut down to test casing and tubing for leaks.

In Harrison County, 10 miles east of Marshall, Arkansas Fuel Co. 1 M. C. McCauley recovered 6 ft. of spotted porosity, with slightly salty taste, at 5,552-69 ft. Operators were coring ahead in shale and limestone below 6,048 ft. Ten miles southeast of Marshall, E. C. Johnson 1 Edna Hood had porosity in the lower Pettit at 6,163 ft., and a show of gas and distillate at 6,163-70 ft. A drill-stem test at that interval, through ¼-in. choke, open 45 minutes, produced gas in 20 seconds and recovered 65 ft. of gas-cut mud and ½ gal. of free distillate. Bottom-hole flowing pressure was 1,025 lb., which increased to 2,500 lb. when shut in. Operators were coring ahead below 6,264 ft. in the Travis Peak.

In Houston County, 6 miles southeast of Grapeland, Magnolia Petroleum Co. 1 J. W. Grounds, had total depth at 8,445 ft. in limestone and shale. Side-wall cores at 8,423 ft. recovered limestone with a slight show of oil and operators were preparing to make a drill-stem test at 8,413-45 ft.

In San Augustine County, 3¾ miles north of the townsite, M. E. Davis et al 1 W. A. Johnson was drilling below 6,926 ft. in limestone on a 9,000-ft. test. Tops released were the Wilcox at 940 ft. and the Midway at 2,085 ft., on an elevation of 405 ft. Humble Oil & Refining Co. 1 P. H. McKnight, Wood County, was shut down for repairs at 12,050 ft.

EAST TEXAS WILDCAT FAILURE

Grayson County: L. O. McMillian and Sherman Hunt 2 Ida Thorn, Samuel Stewart Sur., 10 mi. NW Gordonville, dry, TD 8,004 ft. in shale, broken sand with show oil 3,735-75 ft.

Van Zandt County: W. W. Bradley 4 C. S. Coker Heirs, Wm. Daniels Sur., 2½ mi. NE Van, in Van shallow field area, dry, TD 1,400 ft.

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LA.-ARK.

Pipe Set at 10,732 Ft. To Test Travis Peak

SHREVEPORT.—In Bienville Parish, Lion Chemical Corp. 1 Ozley, 13-17n-6w, drilled from 10,732 to 10,740 ft., total depth, and in that interval found a hard sand carrying salt water that cut drilling mud badly. Operators will run 5½-in. casing to 10,732 ft. and then start testing around 10,324-50 ft., in the Travis Peak.

A test of the James limestone at McAlester Fuel Co. 1-A Patterson, Union County wildcat, was delayed while operators set casing. New perforations are at 3,042-80 ft. Total depth is 7,302 ft., in the Smackover. Electric log tops were: Tuscaloosa 2,900 ft., lower Glen Rose 3,070 ft., Travis Peak 3,452 ft., Cotton Valley 4,900 ft., Buckner 7,235 ft., and the Smackover at 7,260 ft., on an elevation of 215 ft.

In Bossier Parish, Barnsdall Oil Co. 1 D. Johnson, NE SW SE 30-23n-12w, had total depth at 7,510 ft., in the Travis Peak; plugged back to 3,162 ft., perforated 2,845-49 ft., and squeezed. Perforations at 2,827-33 ft., with packer set at 2,780 ft., were swabbed dry; perforations at 2,836-42 ft., with packer at 2,782 ft., swabbed a slight show of oil and gas, with 400 ft. of fluid in the hole.

Other wildcat activity included E. C. Laster 1 Witherspoon, 3-14n-14w, DeSoto Parish, drilling below 3,607 ft. This test had a slight show of oil in the Fredericksburg at 2,870-85 ft. Gulf Refining Co. 1-A W. Washington, 11-15n-8e, Franklin Parish, was drilling below 2,188 ft. Cotton Valley Operators Committee 2 Oliphant-Banks, Cotton Valley field deep test in 34-21n-10w, had total depth at 14,967 ft. in salt. Fish was still in the hole at 11,600 ft., and operators plugged back to 10,900 ft., set liner at 10,253-730 ft., ran testing tool on packer at 10,71[illegible] ft., and swabbed dry with a slight show of gas. Plans were to plug back to approximately 8,500 ft. and test the Davis zone.

NORTH LOUISIANA WILDCAT FAILURES

Caddo Parish: A. Paul Gilbert 1 Holt, SE NE SE 11-22n-16w, dry, TD 3,321 ft., no shows.

Franklin Parish: Gulf Refining Co. 1-A George Washington, NE SW SW 11-15n-8e, dry, TD 910 ft.

C. H. Murphy and Sun Oil Co. 3 J. E. Holt, SW NE 34-16n-8e, dry, TD 4,312 ft.

Ouachita Parish: Petersen Drilling Co. 1 Breece Lbr. Co., NW NW 14-18n-5e, dry, TD 2,790 ft., gas roock 2,310 ft., sand 2,448 ft.

Union Parish: California Co. 1 W. E. Weldon, SE SW NE 24-21n-3w, dry, TD

8,476 ft., DST 7,780-7,800 ft., recovered 11 stands water cushion cut with gas and distillate, flowing bottom-hole pressure 3,625 lb.

ARKANSAS WILDCAT FAILURES

Miller County: E. A. Gabriel 1 Paul Martindale, NW NW 32-14s-28w, dry, TD 5,420 ft., James limestone 3,950 ft., Travis Peak 4,002 ft., Cotton Valley 5,000 ft., elev. 277 ft.

Union County: Plymouth Oil Co. 1 Trammell, W/2 SE SE 7-18s-12w, dry, TD 6,301 ft., no formation tops available.

TEXAS GULF COAST

Potential Field Opener Makes 30 Per Cent Water

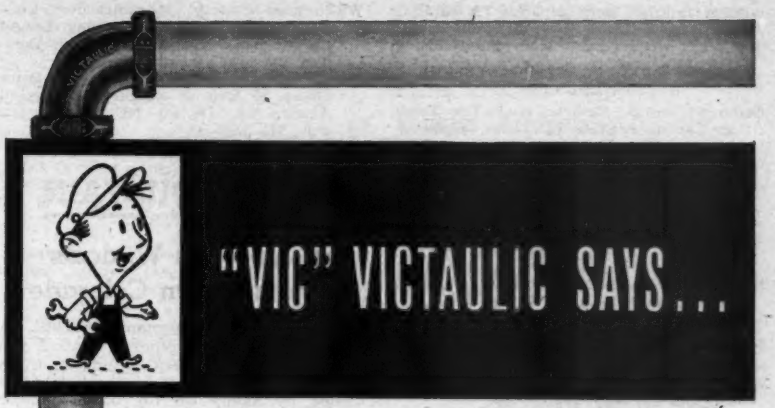
HOUSTON.—Two tests have failed to shut off the water content in a flow from a potential new field opener in San Jacinto County, in the South Evergreen area. The test, Mac Drilling Co. 1 Cynthia Payne in the Vital Flores Survey, 5 miles west-southwest of the Coldspring field, made an initial test with perforations at 7,686-98 ft. It flowed oil, silt, and salt water with 200 psi. on the tubing and 275 psi. on the casing. Perforations were squeezed with cement and operators attempted a dry test, which resulted in a flow of 7 bbl. of fluid hourly through a 10/64-in. choke, 70 per cent oil and 30 per cent salt water with 625 psi. flowing pressure. Perforations were squeezed for a third try in the same zone which is of sands in the upper Wilcox horizon. Total depth of the exploration is 8,260 ft. and 5½-in. pipe is cemented to 7,894 ft.

Humble Oil & Refining Co.'s first successful test in the North Delhi area of Harris County was given a potential gage. It is the 1 North Delhi Unit, No° 4, ½ mile northwest of nearest production and in H&TC Survey, Section 47. It flowed 38.7 bbl. of 55.7°-gravity condensate daily through a ¼-in. choke with 2,325 psi. flowing pressure on the tubing and 2,450 psi. gas pressure on the casing. The well produces 2,991,000 cu. ft. of gas daily along with the condensate flow. Perforations for completion are with 54 shots from 7,060-69 ft.

Hackberry sand production has spurred activity in Orange County in the past month, and several more new tests indicate increased activity of the general area between Orange field, Port Neches field in Orange County and up into the southern portion of Jasper County. Just below the Jasper County line and in Orange County, Texana Petroleum Co. will jointly drill a test with Kirby Petroleum Co. It will be 2 miles north of the recent North Vidor discovery and will be the 1 Horrace Peveto which is located on a 163-acre lease in the Edward Hurst Survey. It is projected to the 8,000-ft. level. Two deep tests which will look for the Hackberry sands were announced by The Texas Co. Both of the tests are in the Port Neches field area of Orange County. The 13-B James V. Polk, in the T. J. Notgrass Survey on the south flank of the field, and the 27 H. J. Kuhn, about midway between northeast and southeast production limits of Port Neches production.

Atlantic Refining Co. 1 W. E. Thurman, wildcat extension try 4,250 ft. northeast of South Hyatt field production in Tyler County, J. Murphy Survey, has set 7-in. protection pipe to 10,284 ft. with hole bottomed at 10,288 ft. The deep producing level is expected just below that depth.

Three new discoveries were officially completed. Atlas Oil & Refining Co.'s West Esperson discovery of Harris County, The Texas Co.'s new oil discovery in Matagorda Bay on State Tract 106, 4 miles north of Port O'Connor in Calhoun County, and Texana Petroleum Co.'s North Cleveland extension discovery in Liberty County. Two



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wildcat failures were reported. A total of 4 new gas wells, 10 new oil wells and 5 dry holes were results from the fields.

TEXAS GULF COAST SUCCESSFUL WILDCATS

Calhoun County: New oil pool—The Texas Co. et al 1 State of Texas, State tr. 106, in Matagorda Bay, 4½ mi. N of Port O'Connor, and 3 mi. NE of Shoreline, approx. NE ext. of NW line of S. Gonzales Grant, top pay 4,970 ft. (Miocene section), TD 11,530 ft., perf. 4,970-78 ft., IP: 192 bbl. oil per day through 3/16-in. choke, TP 600 psi., casing sealed, grav. 27°, no water.

Harris County: New gas-condensate pool, West Esperson—Atlas Oil & Refg. Co. 1 A. B. Cohn Estate, in Meredith Duncan Sur., ¾ mi. W of production on Esperson Dome, TD 9,094 ft., perf. 8,687-95 ft., IP 1,104,000 cu. ft. gas per day through 8/64-in. choke and 42 bbl. condensate per day, gravity 50°.

Refugio County: New oil pool, Wyrick—The Clymore Co., Inc. 2 John F. Zarsky, Sec. 46, Johnson & Pugh Subd. of Bonnie Viey Ranch, TD 6,395 ft. Top pay 4,944 ft., perf. 4,946-48 ft., IP 126 bbl. oil per day through a ⅛-in. choke, GOR 288, TP 525 psi., CP 1,250 psi., gravity 40.7°, no water.

TEXAS GULF COAST WILDCAT FAILURES

Brazoria County: McCarthy Oil & Gas Corp. 1 Zula W. Loggins et al, in J. H. Bell Lge., ¾ mi. S of West Columbia townsite, dry, TD 10,089 ft.

Gonzales County: Quintana Pet. Corp. et al 1 Alfred Speickermann, in William Newman Sur., 7½ mi. SW of Gonzales, dry, TD 12,870 ft.

Karnes County: W. E. Kinnear 1 E. Dittmer, in Brooks & Burleson Sur. 1, 3 mi. S of Runge, dry, TD 7,119 ft.

Victoria County: Wiegand Bros. and Ralph E. Fair 1 J. V. Vandenberge, in SA&MG Sur. 2, 2 mi. N of Telferner townsite, dry, TD 3,015 ft.

Washington County: Magnolia Pet. Co. 1 Charles Reue, in Nester Clay League, off SE flank of Old Clay Creek Dome, dry, TD 9,019 ft.

Wilson County: Sam E. Wilson, Jr. 1 Bruno Johns, in Hrs. of Simon and Juan de Arocha Gr., 1½ mi. NE of Calaveras, dry, TD 3,595 ft.

ROCKY MOUNTAIN

Two Important Wildcats In Southeastern Colorado

DENVER.—Two important wildcats, one a deep and the other a shallow test, are scheduled for early drilling in southeastern Colorado. One of these is to be drilled by Skelly Oil Co. on the Rattlesnake Buttes structure, a high, superimposed on the Apishipa uplift in Las Animas County near the Huerfano County line, the reported location being NW NW NW 24-26s-63w. The other is Rainbow Drilling Co. 1 Cordova, C SE SW 14-27s-65w, Huerfano County. Both are on the west flanks of the Sierra Grande arch, which forms the western boundary of the Anadarko basin. Due west of the arch is the Apishipa uplift. Three wells have recently been drilled by J. M. Huber Corp., Frontier Refining Co., and Sharples Corp. in search of stratigraphic traps on the east side of the Sierra Grande arch. Leasing in the area has been going on for some time and it is estimated that at least 150,000 acres are held by various companies. The Skelly block comprises approximately 30,000 acres. Bay Petroleum Co., Pure Oil Co., and others have leases outside of the Skelly block but in the same general area. The Rainbow Drilling Co. test is located 15 miles to the southwest of the Skelly location. It will be a cable-tool operation to be drilled to 1,500 ft., or to the base of the Morrison. The Skelly well will be a deep test.

Sheldon Dome operation.—The Sheldon field in Fremont County, Wyoming, which was a discovery in the Embar in 1945, in which only one well has been drilled to that horizon, is scheduled for additional development this year. The discovery, 1 Shoshone, C NE NE 16-5n-2w, was drilled to 6,974 ft. and found the Tensleep, topped at 6,743 ft., hard and tight. It was plugged back and completed in the Embar through perforations at 6,265-80 ft., and averaged 48 bbl. of 36.4°-gravity oil per hour on a 2-month test. The operation is owned jointly by Phillips Petroleum Co., Kerr-McGee Oil Co., and Carter Oil Co. The well was shut in until August 1946, when it was opened for further testing, and for nearly 5 months extensive experimental work was done in testing the entire section through perforations, in efforts to locate and shut off the water. It was found, however, that the water, approximately one-third of total fluid, was consistent throughout the formation. The Embar section was found to be approximately 600 ft. thick, twice its normal thickness as a result of an overthrust. The oil is sweet and of a desirable grade. The water contains some sulfur, but separation offers no serious problem and at the end of 1946 the well was recompleted through perforations at 6,545-85 ft. for 300 bbl. per day, after squeezing off all other perforations. Since then production has gradually increased to 350 bbl. of pipe-line oil per day, with little variation in the quantity of water.

Pure wells on production.—The Pure Oil Co. wells on the Worland dome, out in the Big Horn basin, northern Wyoming, will go on production soon as a result of agreements with Ohio Oil Co. and Stanolind Oil & Gas Co. to purchase the crude. Four wells have been completed, of which three are producers at depths below 10,000 ft., and one has been temporarily abandoned before reaching the objective.

Alkali Butte.—Texas Co. 4 Unit, SW NE NW 1-33n-95w, Alkali Butte, Fremont Coun-

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ty, Wyoming, is a potential discovery in the Embar after plugging back from 7,430 ft., and testing progressively through perforations. Last perforations were at 6,623-44 ft., through which it swabbed 10 bbl. per hour for 6 hours and then went to water. Top of Tensleep was at 7,355 ft., that horizon showing salt water. The Embar was topped at 6,527 ft. After squeezing off, it will perforate and test higher up.

South Baggs.—Kerr-McGee-Phillips Petroleum 1 Unit, C SE SE 10-12n-92w, South Baggs, Carbon County, Wyoming, is plugging back from 9,512 ft. and testing upper horizons, perforated with 17 holes at 3,322-30 ft., and swabbed down to 700 ft. when well blew in, making approximately 3,500,000 cu. ft. of gas and 250 bbl. of water. Through perforations at 3,770-85 ft. flow was estimated at 15,000 to 25,000 cu. ft. of gas and 400 bbl. of water per day. Perforations will be squeezed.

New operations.—Eleven new operations were reported, of which seven were in Colorado, two in Wyoming, and two in Montana. The Colorado locations included the Iliff and Rattlesnake Butte wildcats in Huerfano and Las Animas counties referred to above, two development wells in Rangely field, an old well being deepened in Hiawatha field, and one wildcat at Rangely. The latter is Continental Oil Co. 1 Rosella Hall, C SE SE 5-2n-103w. The Hiawatha well being deepened is Mountain Fuel Supply Co. 1 Wheeler, SE NW NW 30-12n-100w, on the west dome, which was completed in 1933 at 1,970 ft. for 7,000,000 cu. ft. of gas per day.

The Wyoming operations included one development well in Garland, and a wildcat on the Seven Mile structure, Carbon County. The latter is California Co.-Phillips Petroleum Co. 1 Christiana, NE NE SE 8-17n-77w. Contract has been let for a 6,000-ft. test to the Tensleep (Casper) formation. It is located 5 miles to the northwest of the Quealey dome Tensleep discovery and between Quealy and Cooper Cove fields. The Montana locations include one in Bowdoin gas field and one in Cut Bank.

Completions.—Six wells were completed with initial production of 2,650 bbl. per day. Five of these, for 2,170 bbl., were in Rangely field in Colorado. The other was in Cat Creek, in Montana, for 480 bbl. There were no wildcat completions. The Cat Creek well was of special interest. It was William Hanlon's 10 Government, SE SW NW 6-14n-31e, on the East dome, and is the first of a series of 12 wells completed in that area to produce from the Brindley sand. The others went to the Ellis sand. Montana Oil and Gas Commission reports Cat Creek production in 1946 at 483,691 bbl. compared with 130,691 bbl. in 1945.

MICHIGAN

Rockford Oil Field Extended by 960-Bbl. Well

SAGINAW.—New importance was attached to the so-called Rockford oil field in Algoma Township, Kent County, as S. L. McCall, of Grand Rapids, completed 1 Hutchins in Section 25 at 2,244 ft., for an estimated initial daily potential, after acid, of 960 bbl. a day. There are now a dozen producing wells, all smaller than the Htuchins, which indicated a field extension.

The week's developments resulted in 17 completions for 5 oil producers, a natural gas well and 11 dry holes, of which 5 were wildcats. The four other wells were small producers in Hope Township, Barry County; in Walker Township, Kent County; Fosters Township, Ogemaw County, and Arbela Township, Tuscola County.

Thirteen new locations were announced for drilling in nine counties, three in Clare County, two each for Allegan and Tuscola, one each for Mecosta, Missaukee, Ottawa, Van Buren, Lake, and Isabella counties.

MICHIGAN WILDCAT FAILURES

Bay County, Gibson Township: Lincoln Drilling Co. 1 W. E. Boeing et al, NE NW NE 23-18n-3e, dry in Dundee, TD 3,058 ft.

Newaygo County, Brooks Township: H. E. Walton 1 Sophia Schumaker, NW NE NE 21-12n-12w, dry in Detroit River, TD 2,950 ft.

Osceola County, Hersey Township: Union Drilling & Producing Co. 1 Leo Cody et al, NE SW SE 16-17n-9w, dry in Dundee, TD 3,764 ft.

Ottawa County, Oliver Township: Clifford A. Perry 1 John Arens, SE NW NW 26-6n-15w, dry in Traverse limestone, TD 1,629 ft.

Tuscola County, Akron Township: E. Edwin Brehm 1 H. L. Begle, NE NE NE 21-15n-8e, dry in Dundee, TD 3,131 ft.

PERMIAN BASIN

Pure to Drill 10,500-Ft. Test in Andrews County

MIDLAND.—Pure Oil Co. last week announced plans to drill a 10,500-ft. Ellenburger test north of the Dollarhide field in southwest Andrews County. Production at Dollarhide is from the Devonian and Silurian. This test, the 1 E. P. Cowden, Section 24, A-32, Public School Lands, will be ¾ mile north and ½ mile east of Magnolia Petroleum Co. 1-C Cowden, which extended Devonian production, and ¼ mile west of Magnolia 2-B Cowden, the Silurian discovery for the area. Sections 16, 17, 24, and 25 were reported to be owned jointly

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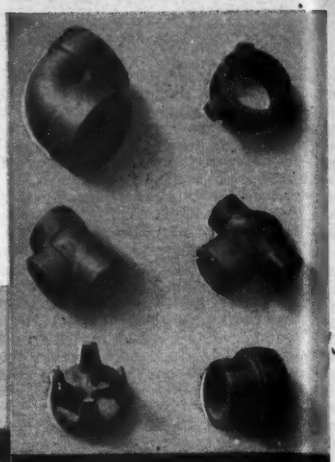

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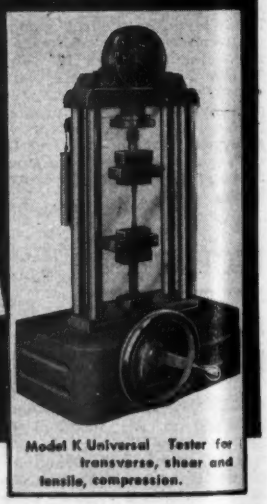

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by Pure and Humble, but it was understood Pure would drill the 1 E. P. Cowden.

At the south end of the new Andector Ellenburger area of northwestern Ector County, Humble 2-G R. B. Cowden ran a drill-stem test in the Permian at 6,170-6,370 ft. Gas came to the surface in 75 minutes and recovery was 270 ft. of oil-cut drilling water, 2,960 ft. of 39.5°-gravity oil, and some 415 ft. of sulfur water. Operators were drilling ahead below 6,515 ft.

Gulf Oil Corp. was planning on completion in the Devonian at its deep test in the Goldsmith area of Ector County. This test, the 421-E Goldsmith, Section 15, Block 44, T&P Survey, perforated at 7,980-8,015 ft. for completion tests. Operators said the Silurian, which also showed for production, would not be tested at this time.

Humble Oil & Refining Co. 6-B W. A. McCutcheon, 1-mile southwest extension to Silurian production on the southeast side of the Keystone field in Winkler County, made a daily flowing potential of more than 789 bbl. of 34.8°-gravity oil, with a gas-oil ratio of 768 to 1, through ½-in. tubing choke, from perforations at 8,045-70, 8,085-8,100 and 8,115-40 ft. This test had total depth at 10,358 ft. in the Simpson, plugged back because it was running low, for the Silurian completion. It is ¼ mile west of Humble's 1-B McCutcheon, an Ellenburger producer.

Sun Oil Co. failed to find commercial oil production in the Ellenburger at its second well in the new Jameson Strawn limestone field of northwestern Coke County. This well, the 1 Fred Jameson, Section 315, Block 1-A, H&TC Survey, is a south offset to the discovery. In an effort to find the water table, operators took a 2-hour drill-stem test at 6,420-21 ft., with packer at 6,394 ft. There was a slight blow of air and the recovery was 100 ft. of drilling mud, with no shows. Perforations were squeezed. A 10-hour test at 6,454-56 ft., with packer at 6,420 ft., recovered 1,260 ft. of fluid, testing about half oil and half salt water, and 180 ft. of clear salt water. The retainer was then set at 6,440 ft. and perforations squeezed. The Strawn pay, topped at 6,136 ft., has indications of being over 400 ft. thick.

Other activity in this area included the 2 Fred Jameson, 2,944 ft. south-southeast of the 1 Fred Jameson, which was fishing for drill collars at 1,590 ft. Sun 1 H. H. Jameson, ¼ mile west of the discovery, was drilling below 4,670 ft. in limestone and shale. Sun was reported planning a fifth operation, late this month, at its 2 Allen Jameson, located ½ mile north of its 1 Allen Jameson. Drilling permit was for 7,500 ft.

Cities Service Oil Co. 1-B Owen, Crockett County discovery, was unable to make a production test last week due to a fishing job for drill collars and bits lost in the hole.

WEST TEXAS WILDCAT FAILURES

Dawson County: Ray Albaugh 1 J. E. Dorsey, Sec. 13, Blk. 33, HE&WT Sur., 3½ mi. S O'Donnell, dry, TD 4,360 ft., anhydrite 1,730 ft., first limestone 3,590 ft., elev. 2,949 ft.

Pecos County: Pure Oil Co. 1 J. S. Oates, Sec. 11, Blk. 121, GC&SF Sur., 25 mi. SW Fort Stockton, dry, TD 1,860 ft., drill-stem test 1,233-70 ft. made flow of air for 6 minutes when packer failed; no shows, no recovery. At 1,274-1,308 ft. test recovered 20 ft. of mud with no shows, hole filled with fresh water at 1,775-80 ft., show gas reported 1,820-23 ft., sulfur water at total depth.

SOUTHEASTERN NEW MEXICO

HOBBS.—A record-size well for New Mexico, and the largest completed this year, was reported last week. Continental Oil Co. 5-B-23 Skaggs, SW NE 23-20s-37e, on the east flank of the Monument field, but in Skaggs Deep field of eastern Lea County, was said to have made a flowing potential of 4,944 bbl. of 42°-gravity oil a day from the Abo (Wolfcamp) of the lower Permian, at 7,710-20 ft. The potential was based on a 3-hour flow of 618 bbl. of oil through 1-in. choke on casing. Gas volume was 759,000 cu. ft. a day, giving it a gas-oil ratio of 1,503 to 1. Total depth was 10,231 ft., into the pre-Cambrian, with plug-back depth and 7-in. casing set at 7,798 ft. Top of the pre-Cambrian was not announced.

OKLAHOMA

Knox Pool in Grady County Getting Dornick Hills Well

IN Grady County, Ohio Oil Co. 1 Woods, NE SW NE 17-3n-5w, which last week reported a recovery of 1,320 ft. of 41.7°-gravity oil on a drill-stem test at 3,480-3,509 ft. in Dornick Hills formation, flowed at an estimated rate of 50-100 bbl. of oil per hour with gas estimated at 3,500,000 cu. ft. on a second drill-stem test at 3,540-75 ft., in Dornick Hills. Total depth is 3,940 ft. Operator contemplates completing well by setting pipe through both sands and perforating. The well is on the west flank of the Knox pool and gives that area a new producing zone.

A well in the Chimneyhill phase of the Hunton is in prospect in Max Pray and R. L. Bauman 1 Gulf-Wynn, NE NE SE 27-5n-4w, McClain County. This test is ¾ mile west of the Bauman Drilling Co. 1 Ainsworth, NE NW SE 26-5n-4w, which produces from the Bois d'Arc phase of the Hunton. Pipe was perforated opposite a 45-ft. section of the Chimneyhill and after the flow was started by swabbing, the well made 167.71 bbl. of oil in 12 hours through ¾-in. choke.

Gutowsky Brothers and Philco Drilling Co. will plug back their 1 Peiter, NE SE 21-25n-12w, Alfalfa County, to test the Mississippi lime topped at 6,040 ft. Drill-stem at 6,045-78 ft. recovered 70 ft. of gas-cut mud and a show of oil. A drill-stem test in the Wilcox at 7,196-7,237 ft. recovered salt water.

In Coal County, Magnolia Petroleum Co. 1 Hockett, NE SE NE 10-2n-8e, had Cromwell at 5,619 ft. Core from 5,637-47 ft. recovered 8 ft. of hard sand, bleeding oil. Simpson was logged at 7,239 ft. Core from 7,288-98 ft. recovered lime, bleeding oil. A drill-stem test at 7,281-7,311 ft. recovered 365 ft. of mud and 120 ft. of oil-cut mud. Core from 7,507-35 ft. showed considerable saturated sand and sandy lime. Coring was continued at 7,738 ft.

OKLAHOMA WILDCAT FAILURES

Cotton County: R. W. Steinmaker 1 Mathis, SE SE NW 36-3s-12w, dry, TD 2,111 ft., sand 1,197-1,204 ft.

H. Bowers 1 Musgrove, SE SE SW 32-2s-11w, dry, TD 1,756 ft., sand 1,654-64 ft.

Bridwell Oil 1 School Land "C," NE NE NE 36-3s-11w, dry, TD 1,926 ft., no tops reported.

Hughes County: S. D. Butcher and E. H. Van Patten 1 Rogers, SE NE NE 16-8n-11e, dry, TD 3,658 ft., Bartlesville 1,960 ft., Booch 2,430 ft., Gilcrease 2,750 ft., Wapanucka 3,334 ft., Union Valley 3,575 ft.

Sohio Petroleum Co. 1 Wallace, SW SE NW 29-9n-11e, dry, TD 3,139 ft., Booch 2,060 ft., Gilcrease 2,530 ft., Wapanucka 2,865 ft., Union Valley 3,098 ft., Cromwell 3,132 ft.

Jefferson County: Davidor Brothers 1 Norman, SE NW SW 13-6s-8w, dry, TD 2,520 ft., no tops reported.

Logan County: Jordan Petroleum and Phillips Petroleum 1 Stark, SW SW NW 7-15n-1e, dry, TD 5,210 ft., Layton 4,295 ft., Oswego 4,830 ft., no Bartlesville present, Mississippi lime 5,190 ft.

Falcon Seaboard 1 Faver, SE SW NW 26-15n-1e, dry, TD 5,600 ft., Skinner 4,790 ft., Woodford 5,072 ft., Hunton 5,092 ft., Sylvan 5,209 ft., Viola 5,307 ft., Second Wilcox 5,540 ft.

L. B. Jackson and Roy L. Kemp 1 Wright, SW SW NE 27-17n-6e, dry, TD 3,030 ft.,

Oklahoma County: Double R Drilling and Sunray 1 Henderson, SW SW SW 24-14n-1w, dry, TD 5,849 ft., Oswego 4,985 ft., Misener 5,482 ft., Hunton 5,486 ft., Sylvan 5,522 ft., Viola 5,633 ft., Wilcox 5,730 ft., Second Wilcox 5,833 ft.

Osage County: Texas Co. 1 Osage, SW NE SE 22-26n-5e, dry, TD 3,061 ft., Big Lime-Oswego 2,620 ft., Burbank sand 2,985 ft.

Pawnee County: Deep Rock et al 1 Dunham, NW NW SW 20-20n-6e, dry, TD 3,603 ft., Mississippi lime 3,45 ft., Woodford 3,472 ft., dolomite 3,511 ft., sandy dolomite 3,523 ft., Wilcox 3,545 ft.

Porter Oil & Gas Co. 1 State, SE SE SE 16-23n-4e, dry, TD 3,873 ft., Mississippi lime 3,462 ft., no Viola present, dolomite 3,795 ft., Wilcox 3,803 ft.

Payne County: Warren Oil Co. 1 Swart, SE SE NE 32-20n-2e, dry, TD 5,139 ft., Oswego 3,945 ft., Mississippi lime 4,396 ft., Woodford 4,536 ft., Sylvan 4,569 ft., dolomite 4,697 ft., Wilcox 4,715 ft., Second Wilcox 4,755 ft., Arbuckle 5,117 ft.

Seminole County: Fred T. Haddock et al 1 Brown, NW SW SE 12-7n-7e, dry, TD 3,542 ft., Earlsboro 2,975 ft., Booch 3,184 ft., Gilcrease 3,330 ft., Cromwell 3,532 ft.

Stephens County: Kadane & Sons 1 Miller, NW NW NE 20-2s-8w, dry, TD 3,003 ft., sand 1,860-80 ft., 1,960-2,005 ft., 2,125-50 ft., 2,626-36 ft., 2,657-82 ft., and 2,714-18 ft.

Joe E. Trigg 1 Hill, NW NW NW 6-2n-7w, dry, TD 9,176 ft., limy sand 8,466-80 ft., 8,495-8,520 ft. and 8,594-8,616 ft., lime 8,709-64 ft. and 8,783-8,922 ft.

KANSAS

Prospective Revival of Old Area in Stafford County

PLAINS EXPLORATION CO. 1 Batman, NW NW SW 2-22s-13w, Stafford County, located less than ¼ mile southeast of the abandoned, one-well South Gates pool in Section 3, has pipe set 1 ft. in the Arbuckle at 3,687 ft., total depth 3,692 ft. The well swabbed 16 bbl. of oil per hour for 4 hours from 1,500 ft. off bottom. Lansing was reported at 3,344 ft., Conglomerate at 3,573 ft., Viola at 3,602 ft., Simpson at 3,639 ft., and Arbuckle at 3,686 ft.

Phil-Han Oil Co. and Bird & Boering 1 Veverka, SE SE SE 7-8s-18w, Rooks County, is a 100-bbl. well after acid treatment. Pipe was set on top of the Arbuckle at 3,405 ft., total depth 3,413 ft. There was no fill-up when the plug was drilled.

Continental Oil Co. 1 Cotton, SE SE NW 14-12s-14w, Trego County, 1 mile east of the Cotton pool, filled up 50 ft. with oil in 16 hours when plug was drilled. Pipe, which had been set at 3,948 ft. or 6 ft. in the Arbuckle, was then perforated from 3,942-48 ft. and the hole filled 80 ft. with oil in 5 hours. The pay zone will be acidized.

No. 1 Ficken, NW NW NE 32-19s-18w, Rush County, 14 miles west of the Ryan pool, which is being drilled by J. M. Huber Corp. and Earl Wakefield, will be drilled deeper. Pipe was set at 4,057 ft. or 2 ft. in the Arbuckle. At a total depth of 4,060 ft. the well bailed ½ bbl. oil per hour. After deepening to 4,090 ft. and treating with 1,000 gal., the well swabbed 11 bbl. oil and 2 bbl. of water in 22 hours.

One mile west of the Stoltenberg pool, Sohio Petroleum Co. and Kiowa Drilling Co. have set pipe in their 1 Horejsi, NW NW NW 12-16s-11w, Barton County. The test was drilled to 3,341 ft., and pipe was set 1 ft. in the Arbuckle at 3,341 ft.

In South Boggs pool, Continental Oil Co. 1 Smith "A," NW NE NE 20-33s-12w, Barber County, found the Simpson 9 ft. higher than in the discovery well which it offsets to the west. The well made a flowing potential of 770 bbl.

KANSAS SUCCESSFUL WILDCAT

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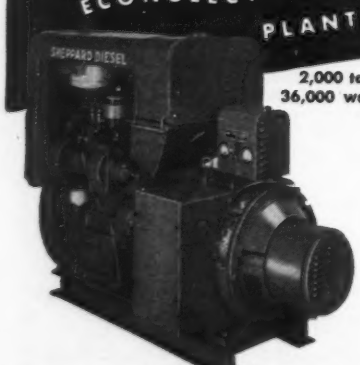

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NW NE 20-13s-21w, pumped 46 bbl. oil from conglomerate at 2,902-33 ft., Topeka 3,243 ft., Lansing-Kansas City 3,573 ft., TD 3,938 ft.

KANSAS WILDCAT FAILURE

Sumner County: Anderson-Prichard and J. M. Huber Corp. 1 Sylvester, NE NW SE 35-31s-1w, dry, TD 4,135 ft., Lansing-Kansas City 3,008 ft., Mississippian 3,627 ft., Kinderhook 4,080 ft., Simpson 4,126 ft.

CALIFORNIA

Wildcat Bacon Hills Area Recovers 500-Ft. Oil on Test

LOS ANGELES.—Seaboard Oil Co.'s wildcat in the Bacon Hills area of Kern County, the 3-21 Seaboard-Bandini, NW SW NW 21-28s-20e, has every appearance of being an important new discovery from the Oceanic zone. On a formation test for water shut off, 20 ft. above the sand, the well showed a mild, steady flow throughout the 45 minutes the tool was open. The test was made through 4 perforations at 7,835 ft. with a 1,000-ft. water cushion, and a ½-in. choke in place. Recovery was 500 ft. of gassy mud and 500 ft. of clean, 36.7°-gravity oil. Bottom hole pressure was recorded at 3,500 psi. When the tool was pulled at the conclusion of the test, it was found to be partially plugged with shale, and the drill pipe partially unloaded during the pulling operation.

Top of the Oceanic sand in the Seaboard wildcat was logged at 7,855 ft. and the base at 7,880 ft. Seven-inch casing with one joint of 5-in. on the bottom to fit inside a 6⅝-in. stub liner was cemented at 7,576 ft., making a full string to a depth of 7,925 ft. Operators are now preparing to gun-perforate and test the Oceanic throughout the interval 7,855-80 ft.

Sunray Oil Corp. has launched a new exploratory campaign southwest of the West Cat Canyon field with the staking of location for the 1 Las Flores in Section 4-8n-33w. The 1 Las Flores is approximately in the center of a 1,470-acre tract recently leased by Sunray, and is about 2 miles southwest of the producing wells of Standard Oil Co. and Palos Verdes Estates, Inc., in the West Cat Canyon field. It is believed that any production found will be in a field separate and distinct from West Cat Canyon.

D. D. Feldman has completed his 2 Richardson Estate, 23-3n-21w, in the West Mountain area of Ventura County, initially flowing at the rate of 1,150 bbl. of oil per day, with gas estimated at 750,000 cu. ft. Flow was through a 12/64-in. bean. The well, which is the best producer finished in the area to date, was drilled to a total depth of 4,800 ft. in the Lower Sespe. Approximately 1,500 ft. of the formation is said to

Oswego 2,560 ft., Pure 2,635 ft., Inola 2,990 ft., sand 3,010 ft.

have been penetrated.

The 2 Richardson Estate is the second well drilled in the area by Feldman. The first venture, north of the present producer, developed a series of mechanical troubles and failed to match expectations.

Standard Oil Co. of California has successfully extinguished the fire at its 2 McGrath, wildcat test in 26-2n-23w, Ventura County, and is building a new derrick to replace the one destroyed by fire. The well had been plugged back from 11,505 ft. to a depth near 8,600 ft., and tools were being pulled when a blowout occurred and the fire resulted. As soon as the hole can be repaired, Standard plans to conduct extensive tests to determine whether or not the blowout indicates the discovery of a new gas reservoir.

Universal Consolidated Oil Co. successfully completed its 11 Sauerdough, 23-29s-21e, during the past week for an initial flow of 583 bbl. of 38.0°-gravity oil daily through a 13/64-in. choke. Production is coming from the Oceanic sand at a total depth of 4,990 ft. The 11 Sauerdough extends the field a short distance to the east.

CALIFORNIA WILDCAT FAILURES

Kern County, Kern River Area: Seaboard Oil Co. 3 Fuhrman, 28-28s-28e, dry, elev. 925 ft., TD 4,025 ft.

Antelope Plains Area: Mace Cox No. 1, 24-26s-18e, dry, TD 790 ft.

Antelope Plains Area: British-American Oil Producing Co. 66-20 U. S. Government, dry, elev. 1,001 ft., TD 2,731 ft.

OHIO, KENTUCKY

Hemlock Grove Pool Well Flows 30 Bbl. After Shot

COLUMBUS.—A good producer was reported in the south part of Hemlock Grove pool in Meigs County, Preston Oil Co. 3 O. D. Ervin, Section 2, Bedford Township found the Berea sand at 1,576-92 ft., with a good show of oil that flowed 30 bbl. after shot. Eleven wells are now drilling in the pool, mostly in the south part.

H. G. Clymer completed a good gas well in Center Township, Monroe County, but at 6 ft. in the sand, a pin was lost for which they are now fishing. The test, on Enoch Craig, Section 21, reached the Berea sand at 1,937 ft.

The St. Peter test in Russia Township, Lorain County, failed to find more than a small show of oil and gas in the sand, which filled with water to within 1,000 ft. of the top. The test, by Hanley & Bird on William Seabold, Lot 36, logged the Trenton at 3,498-4,135 ft. and the St. Peter at 4,146-57 ft.

Industrial Gas Co. reached the Trenton at 5,821 ft. in its deep test on M. J. Wickham, Section 10, Salt Creek Township, Muskingum County.

Stark County continues to lead in new locations with five followed by Muskingum with two, Meigs two, and six scattered. Twenty-eight wells were completed with Stewart leading with eight.

OHIO WILDCAT FAILURES

Ashland County, Sullivan Township: Ohio Fuel Gas 1 W. E. Mayes, Lot 87, no Clinton, TD 2,636 ft.

Jackson County, Jefferson Township: Ohio Fuel Gas 1 Lincoln Myers, Sec. 20, Clinton 2,710-24 ft., TD 2,750 ft.

Lorain County, Russia Township: Hanley & Bird 1 Wm. Seabold, Lot 36, Trenton 3,498-4,135 ft., St. Peter 4,146 ft., TD 4,157 ft.

EASTERN KENTUCKY OPERATIONS

ASHLAND.—One of the biggest producers in the eastern Kentucky field in months was noted during the week on the property of Wilson Damron in Pike County.

Kentucky-West Virginia Gas Co. completed Well No. 5,707 on the Damron land, checked at 1,898 ft., with an open flow of 4,418,000 cu. ft. in Maxon.

The same company completed Well No. 838, W. R. Hall, Sr., property in Floyd County, 3,492 ft., 146,000 cu. ft. in shale; A. S. Well No. 843, William Swain land, Martin County, 528 ft., 315,000 cu. ft. in Salt sand, and Well No. 5,711, Sam Clark, Johnson County, 2,918 ft., 75,000 cu. ft., in Big 6.

New locations were noted on Robert Williams land, Pike County; Grant Green, Magoffin County; Thomas Terry, Knott County; W. R. Hall, Sr., Floyd County, and Joseph Stewart, Knott County.

WESTERN KENTUCKY

OWENSBORO.—Sun Oil Co. 1 Fannie Pritchett, 21-O-22, Henderson County, was

estimated at 350 bbl. from the Tar Springs at 1,904-26 ft. Total depth is 1,926 ft. This is a new producing pay for the Dixie pool, which produces gas from Pennsylvanian and oil from the Cypress.

Carter Oil Co. 1 J. M. Hackett, 16-O-23, Henderson County, is drilling below 1,200 ft. A gas sand at 990-1,021 ft. flowed an estimated volume of 250,000 cu. ft.

Pure Oil Co.-Stanolind Oil & Gas Co. 1 G. Hammons, 2-H-67, Clay County, is plugged back from total depth of 4,002 ft. to 3,693 ft. for further testing.

WESTERN KENTUCKY SUCCESSFUL WILDCAT

Henderson County: Sun Oil Corp. 1 Fannie Pritchett, 21-O-22, Est. 350 bbl. from Tar Springs 1,904-26 ft., TD 1,926 ft., 5-in. at 1,904 ft., new pay in Dixie pool.

WESTERN KENTUCKY WILDCAT FAILURE

Henderson County: Lohman-Johpson et al 1 Trigg Estate, NE SE 14-P-22, elev. 413 ft., dry at 2,710 ft., Menard 1,708 ft., Tar Springs 1,918 ft., Hardinsburg 2,022 ft., Cypress 2,336 ft., Ste. Genevieve 2,558 ft.

INDIANA

EVANSVILLE.—F. A. Calvert et al have set pipe in their 1 Hastings, SW SW NW 10-8s-14w, Posey County, at 2,673 ft. A 137-minute drill-stem test at 2,668-2,710 ft. recovered gas in 52 minutes, 150 ft. of oil, 270 ft. of mud-cut oil, 30 ft. of oil and gas-cut mud, and no water. The McClosky, logged at 2,668-2,710 ft., will also be tested. Total depth is 2,737 ft.

Three miles southwest of Vincennes, Earnest Zink et al 1 Halter, NE NE SE 7-2n-10w, Knox County, drilled to 1,885 ft., has pipe set through the Aux Vases, logged at 1,817-20 ft. A 65-minute drill-stem test at 1,810-85 ft. recovered gas, 105 ft. of oil, and 90 ft. of drilling mud.

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MISSISSIPPI

Mississippi Wildcats Testing Below 6,500 Ft.

JACKSON.—Dwight H. Sandford's 1 School Land, SE SE SW 16-6n-1ew, a 4,000-ft. test 1½ miles northeast of Clinton, in Hinds County, had total depth at 3,516 ft. in sand. A drill-stem test from top of the gas rock, found at 2,908-3,279 ft., with packer at 2,910-14 ft., produced a slight blow of air for 15 minutes and recovered 870 ft. of fluid. Of this, 687 ft. was drilling mud with a rainbow show of oil, and 183 ft. of salt water. Operators shut down for orders. Electric log tops were: Wilcox 1,519 ft. and Midway 2,775 ft., on an elevation of 327 ft.

In Neshoba County, 9 miles northwest of Philadelphia, Slick Oil Co. and Plains Production Co. 1 J. D. Brezeale, NW SW SE 28-12n-10e, was drilling ahead below 3,362 ft. in sand, on its 6,500-ft. test. Cores recovered 6 ft. of sand with no shows, in the Eutaw at 2,687-2,701 ft. At 3,149-60 ft. there was silty shale and ashy sand; and at 3,346-62 ft. the recovery was 1 ft. of tight sandstone, 6 in. of shaly sand, 3 ft. of hard sand with shale streaks, 8 in. of sand, and 4 in. of soft sand, with no shows. Sample tops were: Chalk 1,808 ft., Eutaw 2,683 ft., on an elevation of 398 ft.

Five miles northeast of Yazoo City, Slick Oil and Hewgley Drilling Co. 1 Ingram was last reported drilling below 6,530 ft. in sandy shale. Cores at 5,836-45 ft. recovered coarse-grained, ashy, volcanic sand. At 6,280-90 ft. there was white, glauconitic, fine-grained sandstone, porous in spots, with possible salt water, and no shows.

MISSISSIPPI WILDCAT FAILURE

Hinds County: D. H. Sanford 1 School Land, NE SE SW 16-6n-1w, dry, TD 3,512 ft., no tops reported.

ILLINOIS

Good Oil Show in McClosky One Mile West of Bungay

MATTOON.—About one mile west of the Bungay pool and one mile north of the Blairsville pool, F. J. Fleming-A. J. Swann-E. F. Moran 1 Odell Heirs, SW SW SE 10-4s-7e, Hamilton County, will set pipe on the McClosky, logged at 3,415 ft. A 60-minute drill-stem test at 2,451-61 ft. made gas in 2½ minutes, and 975 ft. of oil, and 115 ft. of salt water. Formations recorded include: Glen Dean 2,698-2,720 ft., Barlow 2,961 ft., Cypress 3,028 ft., Paint Creek 3,124 ft., and Benoist 3,155 ft.

Joe Reznik et al have completed their No. 1 Valter, SE NE 3-9s-9e, Gallatin County, in the Aux Vases at 2,726-39 ft. as an 18-bbl. pumper, after 10-qt. shot at 2,729-33 ft. Total depth is 2,756 ft.

ILLINOIS WILDCAT FAILURES

Fayette County: Edgar White 1 Satterthwaite, NE NW NW 13-6n-2e, dry at 1,721 ft., Glen Dean 1,459 ft., Barlow 1,592 ft., Cypress 1,616 ft., Paint Creek 1,703 ft., Benoist 1,716 ft.

Jefferson County: T. S. Doran 1 Mischka, NW NE NE 20-2s-1e, dry at 2,306 ft., Tar Springs 1,542 ft., Golconda 1,727 ft., Cypress 1,832 ft., Rosiclare 2,182 ft., McClosky 2,232 ft.

Macoupin County: Sun Oil Co. 1 Alford, CNL NW NE 3-9n-6w, dry at 2,552 ft., Maquoketa 1,940 ft., Trenton 2,128 ft. Glenwood 2,536 ft.

McDonough County: W. Vette 1 McCutcheon, SE SW NE 29-4n-4w, dry at 495 ft., Devonian 460 ft.

Wabash County: Chicago Petroleum Corp. No. 1 Valter, SE NE 3-9s-9e, Gallatin County, in the Aux Vases at 2,726-39 ft. as an 18-bbl. pumper, after 10-qt. shot at 2,729-33 ft. Total depth is 2,756 ft.

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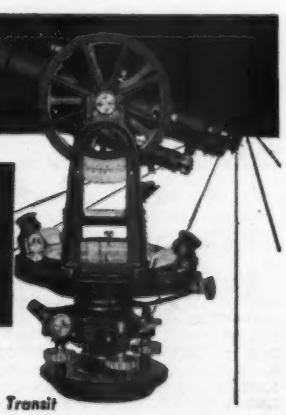

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1 Schwengell, NE NW NE 25-2s-14w, dry at 1,338 ft., Glen Dean 917 ft., Golconda 1,076 ft., Cypress 1,127 ft.

White County: J. W. Rudy 1 Harwood, SW SW NE 2-6s-8e, dry at 3,327 ft., Tar Springs 2,531 ft., Golconda 2,719 ft., Barlow 2,862 ft., Aux Vases 3,164 ft., McClosky 3,301 ft.

CANADIAN FIELDS

Leduc Field Discovery Rated 283 Bbl. Flowing

CHATHAM. — In the new Leduc field, south of Edmonton, Imperial-Leduc 1, LSD 5, 22-50-16w4, bottoming in Devonian limestone at 5,066 ft., has an official initial production figure of 283 bbl. a day through ¼-in. choke. Flush production was 40 bbl. an hour. The well is being shut in for lack of storage and transport facilities. Imperial-Leduc 2, LSD 1, 16-40-26w4, is below 4,550 ft. and is nearing the producing horizon. Imperial-Leduc 3, LSD 10, 26-50-26w4, is below 1,000 ft. and Imperial-Leduc 4, LSD 16, 15-50-26w4, is rigging, and will spud early in April.

Turner Valley. — In the Turner Valley north extension, Foothills Oil & Gas 11, LSD 11, 4-21-3w5, an old limestone producer being deepened for a lower porous horizon, has discontinued drilling at 8,546 ft. after adding 1,600 ft. of Madison lime, and is testing, with considerable evidence of porosity. Royalite Oil 86, LSD 12, 3-21-3w5, which faulted after getting the first Madison contact at 8,951 ft. has reentered the Home sand at 9,585 ft. and is redrilling lower Blairmore below 9,749 ft.

Foremost.—In the Foremost field, southern Alberta, additional large gas production has been secured by McColl-Union 10-D-9-4-9 joint test, LSD 10, 9-4-9w4, finished in the Bow Island sand at 2,237 ft., with 26,400,000 cu. ft. open flow. McColl-Union 6-4-5-10, LSD 6, 4-5-10w4, is nearing completion.

North and west of the gas area, Foremost-Province 13-17-5-11, LSD 8, 17-5-11w4, joint deep test by Standard Oil Co. of California and Imperial Oil Co. of Canada, struck salt water in the Devonian limestone at 4,197 ft. and has been abandoned. McColl-Union 10-B-23-6-10, LSD 10, 23-6-10w4, is rigging.

Provost.—In the Provost area, east-central Alberta, Imperial-Provost 1, LSD 3, 27-37-3w4, finished last June at 2,549 ft., with initial production of 31 bbl. of 21.5° gravity crude and 134,000 cu. ft. gas and which was regarded as a potential discovery well, is being abandoned. Production operations were discontinued after several months when the amount of salt water with the oil made operations uneconomical. The fluid recovery, of which 24 per cent was water in a tight emulsion, amounted to 12 bbl. a day prior to shut down in October. Later wells in the vicinity of No. 1 failed to obtain oil shows, indicating the production from No. 1 was a small, local accumulation.

Jumping Pound.—In the Jumping Pound area, west of Calgary, Shell 5-7-1, LSD 5, 7-25-4w5, encountered the Blairmore contact at 8,020 ft. and is deepening below 8,482 ft., after making an Alberta drilling record of 8,003 ft. in 80 days.

Keystone Valley.—In the Keystone Valley area of the Alberta foothills, northeast of Calgary, Roxana 4-K, LSD 1, 31-26-6w5, contacted the Jumping Pound sand at 6,170 ft. with a substantial gas showing at 6,396 ft., and is deepening.

Official figures.—Official production figures on recent Turner Valley completions show that in North Turner Valley Home-Millarville 24, LSD 12, 33-20-3w5, with Madison at 7,891-8,371 ft., made 1,114 bbl. of 40.0°-gravity crude, initial production, with 1,860,000 cu. ft. gas. Foothills Oil & Gas 25, LSD 6, 9-21-3w5, in the North Extension, with Madison at 8,627-9,157 ft., made 597 bbl. initial production of 40°-gravity oil with 1,006,000 cu. ft. gas.

Lloydminster.—In the Alberta end of the Lloydminster field, Commoil-Lloyd 3, LSD 6, 10-50-1w4, finished at 1,953 ft., is bailing 27 bbl., and is cleaning out to remove sand bridge. Commoil-Lloyd 4, SE LSD 11, 10-50-1w4, deepened to 2,092 ft., was plugged back to 1,956 ft. to test Sparky sand at 1,946-54 ft., Colony sand at 1,767-96 ft., and lower Colony at 1,804-15 ft. may also be tested. West End 1, NW LSD 15. 11-50-2w4, finished at 2,010 ft., with lower Cretaceous at 1,842 ft. and Sparky sand at 2,006 ft., is testing.

SOUTHWEST TEXAS

Continental's Live Oak County Test Promising

CORPUS CHRISTI.—Continental Oil Co. 1-D Albert West, wildcat 3½ miles northwest of George West in Live Oak County, perforated casing at 6,780-94 ft. for a production test. Prior to setting 7-in. at total depth 7,411 ft., a drill-stem test from 6,784-96 ft. recovered 40 ft. of 47.5°-gravity oil after flowing the water cushion, in 7½ minutes with 600 psi. working pressure and 2,000 psi. bottom-hole flowing pressure. Another drill-stem test from 6,798-6,801 ft. recovered 170 ft. of water cushion, cut with oil, and 120 ft. oil-cut mud with 650 psi. bottom-hole flowing pressure. Still another promising test was made at 7,291-96 ft. where it made a good blow and recovered 700 ft. of 35.8°-gravity oil.

Magnolia Petroleum Co.'s wildcat test south of Casa Blanca field in Duval County, 1 Duval County Ranch Co.-State, developed 315 psi. working pressure and flowed gas on an 18-minute drill-stem test at 1,321-24 ft. through ¼-in. choke. A core was taken just below that depth which had oil odor from 1,324-30 ft. and a test was being made. This is in the Cole sand which was topped at 1,318 ft.

Humble Oil & Refining Co.'s major extension well at Borregas field in Kleberg County, flowed a potential gage of 211.17 bbl. of 38.6°-gravity oil per day through a ⅛-in. choke, with a gas ratio of 881 to 1. Tubing pressure was 1,680 psi. The well was completed from perforations at 6,966-78 ft.

A new oil sand was being opened on the LaGloria East flank in Jim Wells County by Magnolia Petroleum Co. 1-A El Contesto Unit. Perforations were made at 7,302-10 ft. for the completion try. A drill-stem operation, prior to the production try, flowed at the rate of 96 bbl. oil per day on ⅛-in. choke with 715 psi. working pressure. The test is in Lot 8, Block 7, subdivision of lands adjoining townsite of LaGloria.

Gasoline Production Corp. 1 Harold E. Yoward, wildcat test 1¼ miles west of Mineral gas-condensate production in Bee County, has set 7-in. casing at 7,818 ft. with a total depth of 7,884 ft., and is scheduled to complete as a new oil-field discovery in that area. The well topped the Slick sand at 7,471 ft. and on a 10-minute test from 7,470-79 ft. it recovered 950 ft. of 40°-gravity oil with 260 psi. working pressure and 2,100 psi. bottom-hole pressure.

Standard Oil Co. of Texas 7 G. B. de Garcia, outpost test 4,200 ft. north-northeast of Alta Mesa production in Brooks County, has indicated a new oil discovery. Total depth of the hole is 6,500 ft. and 8-in. casing is set on the bottom. A drill-stem test from 6,320-24 ft. developed 125 psi. working pressure and recovered six stands of 42°-gravity oil and two joints of oil and mud and salt water on a 20-minute test. Another test at 6,320-28 ft. recovered 1,000 ft. of 42°-gravity oil and 110 ft. of salt water. The operation is in the northwest corner of Share 8-A in the La Encantada Grant, Abstract 97.

Ralph & Dale Rowden et al 1 John P. Akin et al, wildcat test about 2 miles southeast of Cedro Hill field in Duval County, GB&CNG Survey, No. 186, recovered one stand of muddy oil and fresh water on a drill-stem test at 2,460-76 ft. Tool was open 20 minutes with 36 psi. maximum working pressure developed through ¼-in. chokes, top and bottom.

A new gas pay was opened and a discovery of a new field was made by Southern Minerals Corp. 1 S. B. Alley, wildcat test 1½ miles west of Alice field in Jim Wells County, Lot 23, L. G. Collins farm lots. The completion was made in perforations at 3,477-87 ft. where it flowed dry gas and is shut in with 1,500 psi. pressure on both tubing and casing. Total depth of the hole was 5,510 ft. and 5½-in. pipe was cemented to the bottom.

SOUTHWEST TEXAS SUCCESSFUL WILDCATS

Brooks County: New oil pays, Alta Mesa field—Standard Oil Co. of Texas 32 (Lease 1) Mestena Oil & Gas Co., in La Mestena & Gonzalena Gr., dual completion, TD 6,851 ft., top pay 4,515 ft., perf. 4,519-21 ft., IP: 142 bbl. oil per day through a 3/16-in. choke, GOR 565, top pay 4,958 ft., per. 4,965-70 ft., IP 70 bbl. oil per day through ⅛-in. choke, GOR 430, TP 450 psi., gravity 44°, no water.

Duval County: Oil discovery, Cam field—B. C. Graham and Cam Corp. 2 Rosa V. de Benavides, Lot 3, Sec. 24, Cole Pet. Subd., Mariano Arispe Gr. 75, 5 mi. NE of Bruni and 660 ft. SE of 1 Benavides gas discovery, TD 3,367 ft., perf. 2,64-62 ft., top pay 2,650 ft., IP 62 bbl. oil per day through 9/64-in. choke, GOR 200 to 1, TP 155 psi., CP 740 psi., gravity 39°, no water.

McMullen County: W. W. Hawkins 2 Nueces Land & Livestock Co., John T. Moorhead Sur. 234, 5½ mi. N of Munson field, dry, TD 917 ft.

San Patricio County: New gas sand Midway pool—British American Oil Prod. Co. 2 D. I. Coggin, Sec. 82, Geo. H. Paul's Subd. (worked over), TD 6,505 ft., top pay 3,646 ft., perf. 3,647-53 ft., IP: 21,000,000 cu. ft. gas per day on open flow (dry gas).

Starr County: New condensate discovery, Dee Davenport 1 Davenport-State, Sur. 974, 13 mi. NW of Sullivan City and 1½ mi. N of Frost field, TD 5,501 ft., perf. 4,098-4,112 ft., IP gas and spray of condensate through 9/64-in. choke, na gage, gravity 58°, no water, TP 1,450 psi., SIP 1,500 psi.

New oil pay—Kelsey (South) field—C. P. Burton et al 2 Mauro Villareal, Tr. 5, Partn. 2, Santa Cruz Gr., dual completion: Top pay 5,960 ft., TD 7,050 ft., perf. 5,960-70 ft., IP 144 bbl. oil per day through a ⅛-in. choke, CP 975 psi., no water. New pay top 6,062 ft., perf. 6,070-80 ft., IP 145 bbl. oil per day through 9/64-in. choke, GOR 591 to 1, TP 950 psi., gravity 44°, no water.

Webb County: Gravis & Mitchell 1 A. M. Bruni Est., Blk. 36, Brown Subd. of Albercas Grant, 10 mi. SE of Mirando City, dry, TD 2,384 ft.

SOUTHWEST TEXAS WILDCAT FAILURES

Atascosa County: McFarland Drilling Co. 1 Henrietta Krisch Est., Jurgen Dierks Sur. 1,207, 3 mi. N of Poteet, dry, TD 4,095 ft.

Cameron County: Goldrus Drilling Co. and Geo. Echols 1 Al and Lloyd Parker, San Benito Land & Water Co. Subd. of Concepcion de Carricitos Gr., 2½ mi. SE of Harlingen, dry, TD 8,794 ft.

Duval County: Bridwell Oil Co. 1 A. G. Villareal, 2 mi. E of N end of Benavides field, San Andres grant, dry, TD 2,740 ft.

Duval County: Texon Royalty Co. 1 Servando Benavides Hrs., El Mesquite Gr., 7½ mi. NW of Hebbronville, dry, TD 3,568 ft.

Among the Drilling Contractors

Drilling Mud Course Under Way at Odessa

ODESSA, Tex.—The second Odessa course in drilling mud, sponsored by the American Association of Oilwell Drilling Contractors and University of Texas, was started last week. Sessions are held twice daily and are of 2 weeks' duration. The subject of drilling mud includes its functions, all standard mud tests, use of chemicals, control of viscosity, water loss, etc., and the course is offered to anyone in the oil industry who wishes to attend.

During the next 16 weeks, the drilling-mud course will be given at Andrews, Seminole, Kermit, and Monahans, Tex., and Hobbs and Eunice, N. M.

Can-Tex Drilling Co., Calgary, Alta., has the contract for Princess-C.P.R. 14-22-A, LSD 8, 22-20-12w4, the first of a series of tests for California-Standard in the Princess-Steveville field of southeastern Alberta. The well, located ¼ mile south of 16-22-A, which obtained wet gas in the Devonian limestone, is planned as a deep venture to test all the formations down to the Cambrian.

Sam L. Tennant Drilling Co., Blackwell, Okla., is drilling at 3,300 ft. on the Hansen Farm, SW¼ 17-27n-2e, Kay County, Oklahoma, testing Bartlesville sand for Oklahoma Exploration Co. of Tulsa.

Taggart Drilling Co. will drill nine wells for Michigan Gas Storage Co., in Clare County, Michigan. These are the Michigan Gas Storage Co. wells Nos. 243, 244, 247, 248, 249, 250, 251, 252, and 253.

Exploration Drilling Co. has 5,000-ft. contract to drill the Warren Oil Co. 1 W. D. Dent, semiwildcat in southwest of Section 720 of TE&L Survey, southwest of the company's 1 Dowda, in Young County, Texas.

McCarthy & O'Brien, Los Angeles drilling contractors, in combination with Hergins Oil Co., and Alladin Petroleum Corp., has completed 1

Crew of Aggas Drilling Co., Morris, Okla., drilling a test for R. M. Shaw et al, at Holdenville, Okla. The men are: L. J. Taylor, driller; R. B. Ledbetter, derrick man; L. F. Upchurch, floor man; I. L. Baker, backup man; C. G. Carlson, geologist for Earlougher Engineering Co., and C. W. McIntosh, engineer for Earlougher

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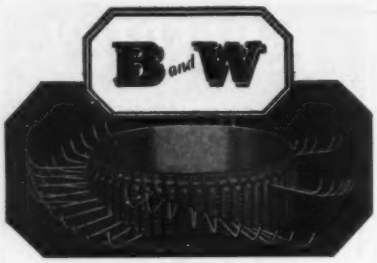

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Turner Drilling Co. has been awarded drilling contract on the Pure Oil Co. A-1 State Beaver Creek, in C W½ SW NW 17-25n-4w, Crawford County, Michigan.

Mealy-Wolfe Drilling Co. will be the contractor on the Cities Service Oil Co. 3 Jacobs-B, in SW SW NE 16-7n-8e, Hughes County, Oklahoma.

Harris Oil Co. is contractor on the Harris Oil Co. and Del Fortney 1 Japink, in NW SE SW 10-3n-14w, Allegan County, Michigan.

Earl Wakefield is drilling The Texas Co. 1 Devine, in NE NE SE 11-28-2e, Sedgwiek County, Kansas. This wildcat, which had set surface pipe at 118 ft., is 2½ miles southwest of the Andover pool, and 9 miles southeast of Wichita.

J. B. Daniel, Fairfield, Tex., has been awarded drilling contract on the J. L. Collins & Co. et al 1 Lillie Barnett, in the southwest corner of a 160-acre tract in the B. G. Balthrope Survey, in the Kerens-Bezette area of Navarro County, East Texas. Contract is for 6,000 ft., and the test was starting.

Falcon Seaboard Drilling Co. and **Barrett Drilling Co.** have staked location for the 1 John Bliss, in SE SE SE 24-8n-1e, a 10-acre offset to the discovery well on the West Burnett pool in eastern Cleveland County, Oklahoma.

Gordon Oil Co. is contractor on the Gordon Oil 4 William Keef, in NE SW NW 3-20n-4e, Arenac County, Michigan.

Parker Drilling Co. has been awarded drilling contract on the California Co.-Phillips Petroleum Co. 1 Christiana, in NE NE SE 8-17n-77w, Carbon County, Wyoming. This will be a 6,000-ft. test to the Tensleep (Casper) formation. It is located 5 miles northwest of the Quealey dome Tensleep discovery.

Northern Drilling Co., Edmonton, Alta., is drilling Manitou 1, LSD 6, 31-48-7w3, and rigging S.A.C. 5, LSD 14, 13-48-28w3, both in the Saskatchewan section of the Lloydminster field, Alberta.

Lupher Drilling Co. has three strings of cable tools running in the Canton, Ohio, gas field. Russ Cline, of the company, is dividing his time between Ohio and Michigan.

H. H. & B. Drilling Co. has completed its 2 Cabbage, in NE SW SW 7-9-18, Rooks County, Kansas, as a maximum 3,000-bbl. well and was preparing to drill the plug at its 2 Hilgers, in NE NW NE 13-9-19. With Bay Petroleum Co., the firm has set 5-in. casing at the 1 Wise, in NE NE NE 1-21-16, Pawnee County, Kansas.

Commonwealth Drilling Co., Calgary, Alta., is finishing Highwood-Lloyd 1, LSD 11, 13-48-28w3, an important test in the Lone Rock section of the Lloydminster field, Alberta. The well offsets a 20,000,000-cu. ft. gasser with potential oil production.

Hewgley Drilling Co. is contractor on the Humble Oil & Refining Co. 1 Cummer Lime & Manufacturing Co., in C SW SW 36-3s-21e, Baker County, Florida. Roads were being built for this wildcat start, which is southwest of Maclenny.

Big West Drilling Co. has staked location for an Ellenburger wildcat in Shackelford County, Texas. It is 1 T. O. Hendrick, 12A, and is 18½ miles northwest of Albany. Permit is to 5,300 ft. with rotary.

Kirkpatrick & Bale, Inc., have drilling contract on the C. W. Barbour and Associates 9 Gray A, which was drilling below 3,600 ft. at SE NE SE 9-1s-3w, northern Carter County, Oklahoma.

Ray & Woolf, Shreveport, have contract for the Katherine Ryan and W. R. Wight 1 J. F. Shearer, in Section 13-13s-26w, Hempstead County, Arkansas. Test, which will be 10 miles west of Hope, is scheduled to go to 4,000 ft., and will test all zones, to the Smackover.

Britton Drilling Co., Olney, Tex., has been awarded drilling contract on the R. B. Farris, J. W. Carter, and George B. McCamey 1 J. L. Schindler, a wildcat in Grayson County, Texas. Location has been staked 1,650 ft. from east and 660 ft. from south lines of a 140-acre tract in the Peter Gass Survey, A-459. Test is on a block of 1,000 acres. Contractor was moving in and preparing to spud.

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Neeld & Hood Drilling Co. was moving in for the 1 Gregson, in NW SW SE 9-3s-13w, Cotton County, Oklahoma. Location is about 2 miles south of Apheatone. Contract is for 1,300 ft.

Harbar Drilling Co. was drilling below 1,530 ft. at its 1 Hilgers, in NE NE SE 13-9-19, an attempted ½-mile south extension to the Southeast Barry pool, Rooks County, Kansas.

Drilling Contractors, Ltd., Calgary, Alta., has contract for Imperial-Leduc 4, LSD 16, 15-50-26w4, in the new Leduc field in Central Alberta, the test to spud early in April. The Devonian limestone around 5,000 ft. is the objective.

Kiowa Drilling Co. is drilling the Solar Oil Co. 1 Tammen, in SW SW SW 24-19-16, Rush County, Kansas, which had reached 2,250 ft. This exploratory test is 1½ miles north of the Ryan pool. Test is being supported by Sinclair Prairie Oil & Gas Co., Globe Oil Co., and Cities Service Oil Co.

Gutowsky Brothers Drilling Co. is preparing to plug back to the Mississippi lime to test its 1 Pelter, wildcat in C NE SE 21-25n-12w, Alfalfa County, Oklahoma, north of Augusta. Drill-stem test of the second Wilcox sand was run at 7,196 to 7,237 ft. and recovered 12 stands of salt water. A drill-stem test in the Mississippi at 6,045-78 ft. recovered 70 ft. of gas-cut mud with a show of oil and the chat at 8,120-96 ft. carried oil staining and odor.

Calvert & Willis, Inc., drilling contractors of Olney, Ill., are currently working on the following contracts: J. J. Lynn 1 Jesse Stanford, wildcat, in 36-3n-7e, Clay County, Illinois; Inland Producers, Inc.-Calvert & Willis, Inc., 6 Biggerstaff, in 6-6s-6e, Hamilton County, Illinois, and Calvert & Willis, Inc., et al 1 David Hastings, wildcat in 10-8s-14w, Posey County, Indiana.

Shaw Petroleums, Lloydminster, Alta., which recently finished drilling West End 1, is starting West End 2, LSD 16, 10-50-2w4, in the northwest (Alberta) extension of the Lloydminster field.

Mayfield Drilling Co. has been awarded drilling contract on the F. A. Callery 1 Voss, in SE SE SW 18-14n-14w, De Soto Parish, Louisiana, in the Kickapoo field.

Flesher & Johnson Drilling Co., Oklahoma City, is contractor on the Ray P. Diehl 1 McCurdy, in C NE NW 8-17n-3w, Logan County, Oklahoma. This will be a Layton sand test, which will be supported by Cities Service Oil Co., Stanolind Oil & Gas Co., and Sun Oil Co.

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Small towns and resorts, financially unable to own and maintain high priced fire pumper, can now afford fire protection. Porto-Pump can be mounted in rear of light truck, motor scooter or trailer.

Independently powered, self sufficient and engineered for continuous use at consistent high efficiency, the rubber impellers deliver over 40 U. S. gallons per minute at 120 lb. pressure by actual flow-meter test.

Where hydrants are not available, use water from ditches, lake or cistern. Pressure and volume losses due to abrasive action of dirty water are avoided by Porto-Pump's rubber impellers.

SOME DISTRIBUTOR TERRITORIES AVAILABLE

PORTO-PUMP, INCORPORATED
227 IRON STREET, DETROIT 7, MICH

STATISTICS and T

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 29, 1947

	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1947				
	Comp.	Oil	Gas	Dry	Footage	1947	1946	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York§	21	10	0	*11	30,472	337	380	0	0	0	0	0	3	0	0	2	5
Pennsylvania	50	24	5	†21	81,650	774	1,011	0	0	0	0	0	3	0	0	2	5
West Virginia	14	0	11	‡3	46,268	207	170	0	0	0	0	0	3	0	0	2	5
Ohio	28	15	5	8	57,562	293	264	0	0	0	3	3	0	0	1	14	15
Indiana§	8	4	0	‡4	15,178	120	68	0	0	0	0	0	3	0	*0	11	14
Kentucky	18	7	4	7	27,892	106	102	1	0	0	1	2	2	0	0	9	11
Illinois	33	16	0	17	85,913	434	475	0	0	0	6	6	16	0	0	67	83
Michigan	17	5	1	11	47,123	151	155	0	0	0	5	4	1	0	3	57	61
Kansas	33	20	1	12	105,597	617	496	1	0	0	0	1	11	0	6	66	83
Neb., Mo., Iowa	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	2	2
Oklahoma	94	48	8	38	281,325	991	592	0	0	0	17	17	21	0	2	183	206
Texas	188	117	12	59	837,689	1,970	1,908	7	2	1	26	36	68	13	18	308	407
North Central (Dist. 7B & 9)	64	32	1	¶31	167,716	600	648	2	0	0	10	12	29	0	5	109	143
West (Dist. 7C & 8)	33	28	0	5	140,221	480	410	0	0	0	2	2	6	0	2	38	46
Panhandle (Dist. 10)	10	5	5	0	34,367	113	92	0	0	0	0	0	1	0	0	0	1
Eastern (Dist. 5 & 6)	8	4	2	2	47,170	110	186	0	0	0	2	2	1	0	1	27	29
Gulf Coast (Dist. 3)	41	27	2	12	274,755	385	441	2	1	0	6	9	16	8	8	64	96
Southwest (Dist. 1, 2 & 4)	32	21	2	9	173,460	282	131	3	1	1	6	11	15	5	2	70	92
Louisiana	23	13	5	5	133,576	269	312	0	0	2	1	3	11	6	2	35	54
Northern	15	10	2	3	60,032	131	157	0	0	0	0	0	0	0	0	20	20
Southern	8	3	3	2	73,544	138	155	0	0	2	1	3	11	6	2	15	34
Arkansas	5	2	0	3	19,362	54	40	0	0	0	1	1	0	0	0	8	8
Mississippi	4	2	2	0	30,517	82	60	0	0	0	1	1	0	0	1	20	21
Southeastern States	1	1	0	0	3,280	13	12	0	0	0	0	0	0	0	0	11	11
Montana	1	1	0	0	1,820	39	60	0	0	0	0	0	0	0	0	8	8
Wyoming	0	0	0	0	0	53	47	0	0	0	0	0	4	0	1	10	15
Colorado-Utah	5	5	0	0	31,815	39	27	0	0	0	0	0	1	0	0	7	8
New Mexico	19	18	1	0	82,567	126	100	0	0	0	0	0	2	0	1	10	13
California	6	3	0	3	24,671	448	447	0	0	0	3	3	5	0	0	69	74
Total United States§	568	311	55	202	1,944,277	7,125	6,730	9	2	3	65	79	148	19	35	897	1,099
Total previous week	508	272	63	173	1,758,087	6,578	6,181	12	0	3	62	77	134	17	32	825	1,008
Total March 30, 1946	531	299	45	187	1,787,417			10	2	3	69	84	102	7	28	690	827

Service wells included: *11, †21, ‡1, ¶2. §Cumulative totals revised.

CRUDE PRICES AND REFINERY ACTIVITY

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.40	....	....	....
19-19.9	1.45	....	....	....
20-20.9	1.49	$1.55	....	$1.42
21-21.9	1.53	1.57	....	1.44
22-22.9	1.57	1.59	....	1.46
23-23.9	1.60	1.61	....	1.48
24-24.9	1.64	1.63	$1.86	1.50
25-25.9	1.68	1.65	1.88	1.52
26-26.9	1.71	1.67	1.90	1.54
27-27.9	1.75	1.69	1.92	1.56
28-28.9	1.79	1.71	1.94	1.58
29-29.9	1.82	1.73	1.96	1.60
30-30.9	1.86	1.75	1.98	1.62
31-31.9	....	1.77	2.00	1.64
32-32.9	....	1.79	2.02	1.66
33-33.9	....	1.81	2.04	1.68
34-34.9	....	1.83	2.06	1.70
35-35.9	....	1.85	2.08	1.72
36-36.9	....	1.87	2.10	1.74
37-37.9	....	1.89	2.12	1.76
38-38.9	....	1.91	2.14	1.78
39-39.9	....	1.93	2.16	1.80
40 and above	....	1.95	2.18	1.82

*For crude from Daboval, El Campo, and Sandy Point. †Includes Lea County, New Mexico.

A.P.I. REFINERY REPORT, WEEK ENDED MARCH 22

District—	Crude runs, daily avg.	Production				Stocks at refineries, bulk terminals, in transit and in pipe lines			
		Gasoline†	Kerosene	Gas & dist. oil	Residual	Gasoline*	Kerosene	Gas & dist. oil	Residual
East Coast	787	1,777	272	1,264	1,820	22,516	4,394	9,412	5,912
Appalachian:									
Dist. 1	107	286	52	93	86	2,633	204	387	203
Dist. 2	64	212	8	57	98	974	21	67	77
Ind., Ill., Ky.	820	2,852	331	962	1,099	22,571	1,120	2,374	2,006
Okla., Kans., Mo.	398	1,415	176	447	459	10,951	336	1,146	883
Inland Texas	214	945	137	98	350	4,632	168	301	745
Texas Gulf	1,086	3,118	661	1,457	1,613	15,348	1,877	6,040	5,072
Louisiana Gulf	363	965	329	464	389	5,624	677	1,992	1,386
N. La. and Ark.	65	179	50	53	105	1,922	276	541	122
Rocky Mountain:									
New Mexico	11	37	4	9	24	86	15	33	37
Other	129	421	10	159	214	3,167	44	469	712
California	840	2,233	95	905	2,364	16,102	740	10,231	25,548
March 22, 1947	4,885	14,440	2,125	5,968	8,621	106,526	9,872	32,993	42,703
March 15, 1947	4,986	15,125	2,230	6,025	8,916	106,813	10,501	34,384	43,734
March 23, 1946	4,690	13,250	2,369	5,644	8,469	104,330	8,669	27,775	37,853

Figures are in barrels of 42 gal. each. They include reported totals plus an estimate of unreported amounts and are therefore on a Bureau of Mines basis.
*Finished and unfinished. †At refineries including natural blended.

FLAT CRUDE PRICES

Representative posted schedules per bbl.

East Texas	$1.95
Kettleman Hills, California*	1.94
Beauregard Parish	1.90
Illinois Basin	2.07
Pecos County, Texas (Yates)	1.65
Bradford, Pennsylvania	3.91
Eastern Ill. and Western Ind.†	2.07
Tomball, Texas Gulf Coast	2.10

*37°-37.9°. †35° and above.

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 29 crude oil	B. of M. Mar. demand	Mar. 22 crude oil
Alabama	1,000	1,200	950
Arkansas	79,900	79,000	81,400
California	906,400	850,000	912,600
Colorado	37,560	38,000	36,080
Eastern	64,500	64,200	65,800
Florida	650	200	740
Illinois	190,900	210,000	187,100
Indiana	18,000	18,000	18,100
Kansas	281,150	270,000	267,750
Kentucky	27,400	29,000	27,200
Louisiana	414,000	400,000	415,350
North Louisiana	102,550	.....	103,900
South Louisiana	311,450	.....	311,450
Michigan	44,230	47,000	41,165
Mississippi	87,245	77,000	88,345
Montana	22,480	24,000	22,640
Nebraska	650	700	650
New Mexico	103,900	101,000	103,900
Oklahoma	370,400	375,000	367,850
Texas	2,129,750	2,060,000	2,129,750
District 1 (Southwest)	20,550	.....	20,550
District 2 (Southwest)	157,900	.....	157,900
District 4 (Southwest)	242,000	.....	242,000
District 3 (Gulf Coast)	487,300	.....	487,300
District 5 (Eastern)	38,290	.....	38,290
District 6 (Eastern)	110,995	.....	110,995
East Texas field	313,000	.....	313,000
District 7-C (West)	34,890	.....	34,890
District 8 (West)	473,725	.....	473,725
District 7-B (W. Central)	36,425	.....	36,425
District 9 (N. Central)	130,000	.....	130,000
District 10 (Panhandle)	84,675	.....	84,675
Wyoming	107,890	100,000	109,430
Miscellaneous	.....	700	.....
Total United States	*4,888,005	4,745,000	4,876,800

Change from prev. week, up 11,205

Total production, January 1-March 29 ..... †420,865,530 bbl.
Same period last year (crude plus condensate) .. 410,704,690 bbl.

*Not incl. 25,000 bbl. condensate. †Incl. 2,248,080 bbl. condensate.

CRUDE-OIL STOCKS 225,720,000 bbl. as of March 22—up 3,379,000 bbl. One year ago 225,153,000 bbl.

GASOLINE STOCKS 106,526,000 bbl. as of March 22—down 287,000 bbl. One year ago 104,330,000 bbl.

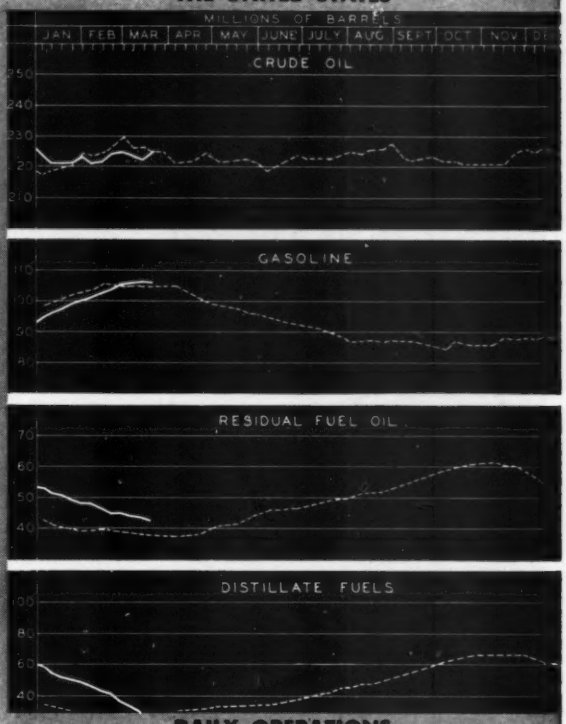
RESIDUAL FUEL-OIL STOCKS 42,703,000 bbl. as of March 22—down 1,031,000 bbl. One year ago 37,853,000 bbl.

GAS OIL AND DISTILLATE STOCKS 32,993,000 bbl. as of March 22—down 1,391,000 bbl. One year ago 37,853,000 bbl.

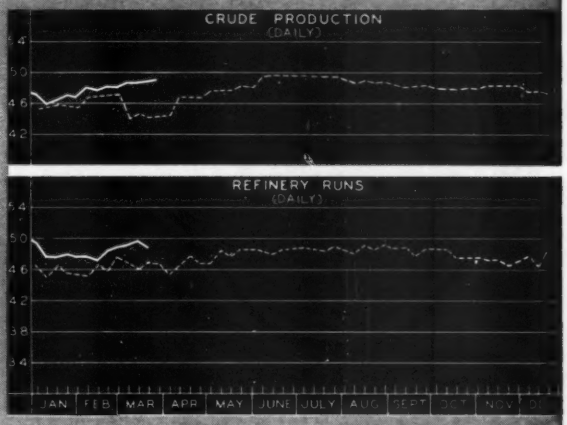
CRUDE-OIL PRODUCTION 4,888,005 bbl. as of March 29—up 11,205 bbl. One year ago 4,417,370 bbl.

REFINERY RUNS 4,885,000 bbl. daily week ended March 22—down 101,000 bbl. One year ago 4,690,000 bbl.

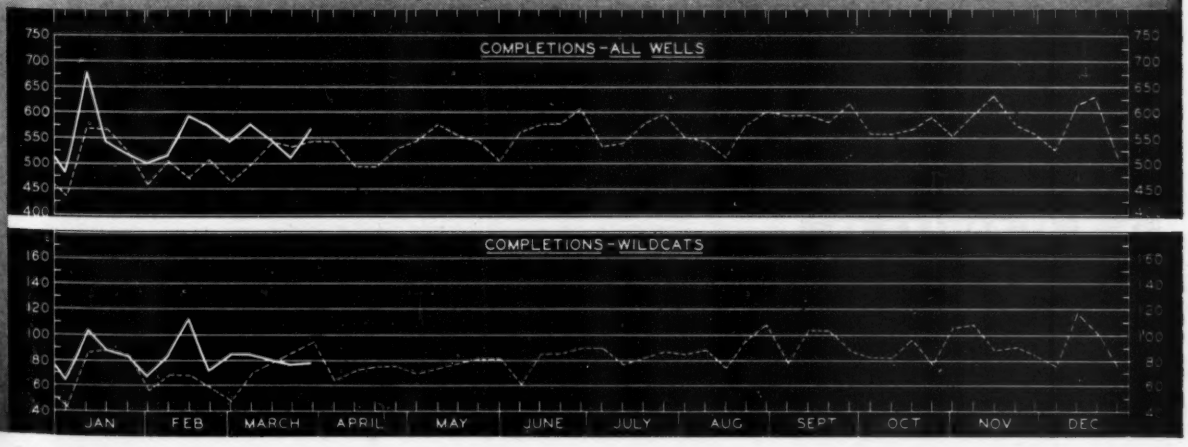
OIL STOCKS IN THE UNITED STATES



DAILY OPERATIONS



Solid line charts weekly completions, service wells in Eastern area included.



"Stabbing pipe in oil field"

The best known safety hat in the world. Tops in every field—oil, structural work, dam construction—wherever head hazards exist. Made of super-tough aluminum alloy, ribbed for extra strength, with adjustable, replaceable, full-floating head-band. Weighs only 11¾ ounces.

Write for bulletin and prices

McDonald

SAFE-T-HAT

B. F. McDONALD CO.

Manufacturers & Distributors of Industrial Safety Equipment

5104 SOUTH HOOVER ST.
LOS ANGELES 37, CALIF.
Other Offices in San Francisco and Houston

MARKETS

CONTINUED heavy demand for petroleum products, a shortage of tank cars, and record high prices for heavy fuel oil characterized market reports in the Mid-Continent and Midwestern areas early this week.

Cold weather throughout much of the eastern and north central sections intensified activity in the burning-oil market at a time when market movement normally shifts from this group of products to motor fuel.

No. 2 distillate was reported particularly tight with some spot-market movement at 6½ cents. Kerosene supplies also were closely held; prices generally ranged around 7 cents where material was available.

Many refiners continued efforts to improve their storage position to meet an anticipated record heavy consumption of motor fuel this summer. Interrefinery sales at prevailing prices were reported.

Tank-car suppliers were nearly unanimous in reporting a scarcity of tank cars. One Mid-Continent supplier said he was on an average 2 weeks behind in orders. Slow rail movement, unimproved despite the end of severe winter weather, was blamed by several sales officials. One cited a 5 to 6-day rail time from Kansas City to Southwestern Oklahoma, approximately twice as long as formerly.

The spectacularly rising market in residual fuel oil continued to hold attention. One refiner reported sales of No. 6 at $1.85 a barrel and $1.95 for No. 5. These prices appeared outstanding, however, and the more normal range for spot-market sales appeared to be between $1.60 and $1.75 a barrel. Much of this demand appeared to be stemming from the requirements of industrial plants which were actively bidding for fuel oil with, as one supplier put it, "price not a consideration."

In New York, residual, No. 2, and kerosene supplies were reported tight. Prices were holding with very little No. 2 moving as the new levels established the week previous as a result of the general crude-oil advance.

Raises in tank-wagon prices of products following the crude increase brought repercussions in the Oklahoma and Texas legislatures. Resolutions were introduced calling for investigations of the increases. Earlier, California's Governor Warren criticized price increases on the West Coast. He was answered by producer representatives who asserted he was confusing a political with an economic situation.

Continental Oil Co. raised its tank-wagon price on gasoline ½ cent in Oklahoma and ⅜ cent in the Rocky Mountain area. The company pointed out the increases reflected the strong tank-car market and similar products advances in other areas. Tank-wagon prices generally were approximately 1 cent above those prevailing before the crude increase.

Commenting on the tight fuel-oil market, the bulletin of the National Association of Purchasing Agents this week said:

"The tight bunker C and heavy distillate fuel-oil supply situation has been greatly aggravated through the Mideastern and Northeastern states by the severe winter and stormy weather which slowed all means of transport, especially rail and barge. In many areas the fuel-oil demand was increased as a result of the natural-gas shortage. Exports of all grades of fuel oil and gasoline have continued at high levels, and the offshore requirements of merchant marine and the Navy are reported to be on the increase. . . . It has been reliably reported that ship sailings at various points along the Atlantic Coast are being delayed awaiting delivery of Bunker C fuel. . . ."

Representative spot-market quotations of leading suppliers as of last Monday morning. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel.

GASOLINE, KEROSENE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor	Texas Gulf Coast
Regular gasoline, 73-75 octane	8-8.5	10.1-10.4* 9.2- 9.4†	7.75-8
Premium gasoline, 78-80 octane	8.75-9.5	10.2-12	8.5 -9
42-44 w.w. kerosene	6.75-7	7.8	6.75-6.875
No. 2 straw fuel oil	6.125-6.375	6.8-6.9	5.5-5.75
No. 6 residual	$1.60-1.75	$2.22	$1.55-1.60

*Branded (74-76 octane); †Unbranded (74-76 octane).

NATURAL GASOLINE

	Group 3	North Texas
Grade 26-70	5.375	4.875
Grade 18-55	6.45	5.85

LUBRICATING OILS

Mid-Continent

130-160 vis. D bright stock, 0-10 p.p.	29
200 vis. No. 3 neutral, 0-10 p.p.	19

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	11-12.5
750 vis., No. 3-4 neutral	13-15.25
2,000 No. 5-6 neutral	14.5-16.75

Western Pennsylvania

145-155 vis. 10 p.t. bright stock	40
180 vis. 0 p.t. neutral	42

Equipment Men in the News

Jones & Laughlin Makes Personnel Shifts

Jones & Laughlin Supply Co., Tulsa, announces the appointment of H. L. Wilkins, Tulsa, and A. G. Bastian, Longview, Tex.,

H. L. WILKINS

A. G. BASTIAN

as assistant sales managers. Wilkins was formerly manager of branch stores, a position created better to handle difficult operating problems in store management during the wartime period. Store operation and supervision is now being directed by sales personnel.

Bastian, formerly general salesman in the East Texas district, will continue to make his headquarters in Longview.

M. L. Eubank, Longview, formerly salesman for the East Texas district, has been made district sales manager for that district. W. O. Hardy, Tulsa city salesman, has been made district sales manager for the Kansas district, succeeding C. E. Robertson, resigned. Hardy will be located in Wichita.

Bethlehem Adds Huber Scrapers to Its Line

Bethlehem Supply Co. has added Huber scrapers to its list of materials sold to oil country operators in an effort to maintain a complete line of supplies for all oil country requirements. The Huber scrapers are manufactured by J. M. Huber Corp. and are attached to Bethlehem sucker rods at the plant in Borger, Tex. Huber scrapers with automatic rotation are used to prevent paraffin accumulation in pumping wells. Stocks for 2-in. tubing are now available at Borger, Pampa, Sundown and Houston in Texas, and Artesia and Hobbs in New Mexico. Huber scrapers for sucker rods to be used with 2½-in. tubing are also immediately available from Borger.

Pebworth Odessa Manager

R. L. Pebworth, former manager of the Houston store of the Continental Supply Co., has reentered the company's employ as manager of the Odessa, Tex., store. He succeeds H. W. Carter, who will serve as field salesman at the same point.

Hill Director of Factory Sales

T. B. Hill has been named director of factory sales for Gar Wood Industries, Inc., it is announced by W. H. Hammond, vice president in charge of sales. Hill was formerly district manager of the general line with headquarters in Chicago. In his new post he will supervise all factory sales activities, including those of the company's Buckeye Traction Ditcher and St. Paul Hydraulic Hoist divisions. Hammond also announced the three following Gar Wood appointments: Nick Etten, first baseman of the New York Yankees, has become associated with the Chicago branch as assistant to the manager. Ben C. Helm, a veteran of more than 35 years in the automotive and allied industries, has been appointed to Hammond's staff. William H. Lingner, formerly with the hoist and body sales department, has been appointed assistant manager of the San Francisco branch.

Chatneuff Houston District Manager

George C. Chatneuff has been appointed district manager of the Houston territory of the Bridgeport Brass Co., Bridgeport, Conn., with office and warehouse located at 2216 Walker Avenue, Houston, it is announced by Austin R. Zender, vice president in charge of sales. Prior to his promotion, Chatneuff was connected with the company's St. Louis office, serving the oil-refining industry in Oklahoma and Kansas.

Haddox Manager of Tubular Department

Appointment of Ralph Haddox, of Charleston, W. Va., as assistant manager of the tubular department of Oil Well Supply Co., is announced by Lloyd E. Tracy, vice president and general manager of sales of this United States Steel subsidiary. Haddox has been president and general manager of the United Pipe & Supply Corp. of Charleston.

R. A. HADDOX

Production Engineering Laboratories at Oklahoma City

The recently organized Production Engineering Laboratories have established their headquarters at 7212 North May Avenue, Oklahoma City. New equipment installed provides oil-field service on core analyses, bottom-hole pressures, gas-oil ratios, water analyses, and a number of A.S.T.M. tests. The firm also engages in preparation of field studies for secondary-recovery operations.

Ward M. Edinger of the firm is a chemical-engineering graduate from University of Missouri and has had much experience in oil-field engineering and test work, including services with Sinclair Prairie Oil Co. in Kansas and Oklahoma, with Mid-Continent Petroleum Corp. at Tulsa, and with Core Laboratories, Inc., in the Mid-Continent and several Texas areas. He was chief engineer for Harper & Turner Oil Co. at Oklahoma City before the new service business was initiated.

James Lee Donelan of the firm received his engineering training at University of Kansas and was later in business for himself, in Central American activities, and with Core Laboratories, Inc., before engaging in business with the new firm.

Dresser Joins Santa Fe

Santa Fe Tank & Tower Co., with main office in Los Angeles, has announced the addition of Harold A. Dresser to its engineering staff, in charge of the cooling-equipment division. Dresser, an alumnus of California Institute of Technology, has been associated with the cooling-equipment industry since 1926. He started with the field construction force, graduating to the engineering department where he took an active part in the general development and experimentation of new-type towers. For the past 15 years he has been a member of the California National Gasoline Association.

Independent Eastern Expands Fort Worth Office

John H. Wilson, vice president of Independent Exploration Co., has announced plans for the expansion of the firm's Fort Worth office which serves North and West Texas and the Rocky Mountain states. Wilson will continue in charge of all operations in these areas. George H. Harrington, Jr., specialist in gravity-meter work, is moving to Fort Worth from the Houston office to become assistant manager in charge of gravity-survey work. On March 31 the company occupied new quarters at 1411 Electric Building, Fort Worth, and a number of employes will be added to the office staff. Spencer R. Normand is office manager.

J. H. WILSON

Bowen Celebrates Twenty-fifth Anniversary

At an anniversary dinner held recently S. R. Bowen Co. celebrated the organization's founding at Huntington Beach by S. R. Bowen in 1921 by presenting the employes with pins for 5, 10, 20, and 25 years' service. Special recognition was given to J. A. Wilcox, president; S. Siracusa, treasurer; and A. G. Baumbach, as these men have been with the company since its inception in 1921. The name Bowen covers both S. R. Bowen Co. and Bowen Fishing Tool Co., both California corporations. S. R. Bowen Co. manufactures the tools which are used in every oil-producing country in the world and Bowen Fishing Tool Co. covers the servicing of tools to the oil industry of the United States.

Royse Heads Fluor Houston Office

C. F. "Fred" Royse, formerly with Griscom-Russell Co., has been appointed district engineer of The Fluor Corp., Ltd., in charge of its Houston office.

Mooney General Manager Of Texasteel

J. R. Mooney was recently appointed general manager of Texasteel Manufacturing Co., Fort Worth, makers of electric steel sucker rods and other subsurface equipment. To take the Texasteel post, Mooney resigned as manager of one of the world's largest firms of inspection and consulting engineers. He is an active member of A.I.M.E., A.R.E.A., A.S.T.M., A.P.I. and the Iron and Steel Institute, American Society for Metals, and Western Society of Engineers, and is a past secretary and director of the Chicago Engineers Club.

Skinner Returns to United States

Houston Oil Field Material Co.'s South American representative, D. U. Skinner, has recently returned to the United States. He will remain in the states for approximately 6 weeks and will then return to his headquarters in Caracas, Venezuela. Skinner has been aiding in sales and serving as a consultant for cutting and fishing-tool problems in Central and South America for the past 6 months.

Classified Advertising

The Market Place for the Oil Industry

UNDISPLAYED

All ads except Situations Wanted, 10 cents a word. Minimum charge, $2.00 per insertion.
Situations Wanted ads, 5 cents a word. Minimum charge, $1.00 per insertion.
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Box Numbers count 9 words when replies are to be sent to our Tulsa Office. Replies forwarded without charge.

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COPY DEADLINE, 9:00 a.m. Monday prior to each week's issue.

THE OIL AND GAS JOURNAL
P. O. Box 1260, TULSA, OKLAHOMA

EQUIPMENT FOR SALE

SPUDDER—Fort Worth Spudder D located on siding in Tulsa. Travco Equipment Co., 110 Midco Bldg., Tulsa, Oklahoma. Phone 5-2251.

FOR CABLE TOOLS
see
DEGEN PIPE AND SUPPLY CO.
Box 107, Red Fork Station, Tulsa, Oklahoma

FOR SALE: 1—Wichita 66 Spudder, 1—LeRoi engine, tools from 15½ to 7 inch. Krohler light plant outfit complete. Priced to sell. Phone 589, Walter A. Hale, P. O. Box 2437, Cut Bank, Montana.

FOR SALE: Pumping Units. All types & sizes. New and used. Bridgeports, Jensens, Americans, Atlas, Ideco, with or without Power. Glenn Supply Co., 3600 Sand Springs Road. Phone 3-9607, Tulsa, Okla.

FOR SALE: Two (2) four-wheel drive seismograph or core drill water trucks, mounted on 4x4 Army trucks. Approximately 450 gal. capacity tanks. Equipped with winch and tool boxes. Box B-654, The Oil and Gas Journal, Tulsa, Oklahoma.

EQUIPMENT FOR SALE

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